DOCUMENT RESUME

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ABSTRACT

This instructional package is one of two designed for use by regular vocational students in the vocational area of small engine repair service. Contained in this document are forty-nine learning modules organized into eleven units: test equipment; motorcycle; engine removal and replacement; machining; tune-ups; short blocks; storage; filling out forms; ring and piston service; valve service; and overhaul. Each module includes these elements: a performance objective page telling what will be learned, what materials will be needed, and how the student will be evaluated; information page (not always included) providing information needed to perform the activity; and job step pages which detail steps necessary to do the task. Visuals are included with the explanation. (This document and CE 017 579 are one of three sets of learning modules on small engine repair. The other two sets are written in formats designed for visually impaired and low reader-educable mentally impaired students. The modules are part of a total set which includes over 1,300 written for different student populations. Building maintenance, dietetic assistant, medical assistant, and graphics are the other vocational areas covered.) (JH)

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ED158102

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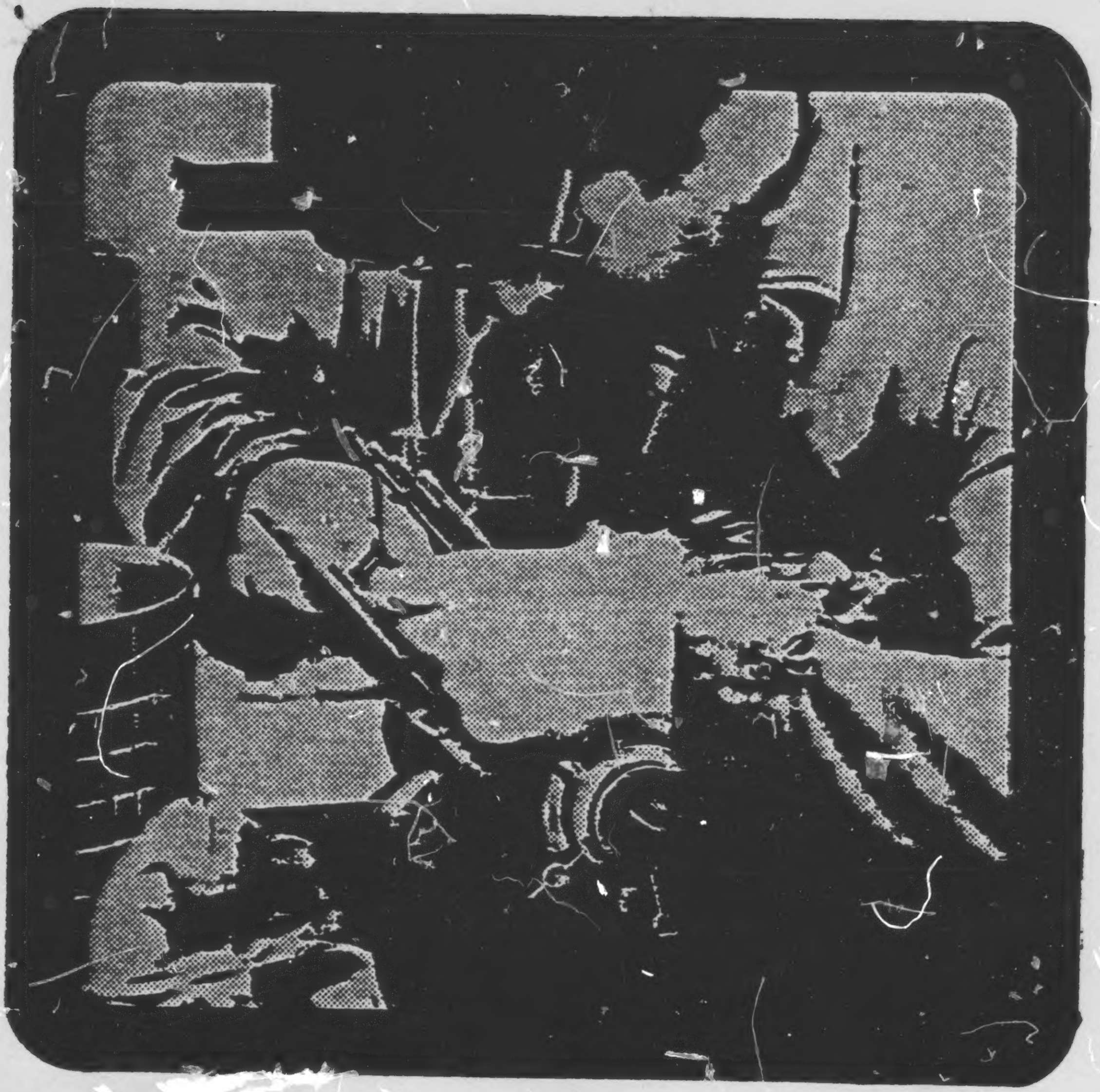
TO:
MULTIPLE LEARNING STRATEGIES PROJECT

SMALL ENGINE REPAIR SERVICE
Regular Vocational [Vol. 2] (2)

CE 017 580



small engine repair

unit: Test Equipment

capital area career center

module: 7501 13 001 date: 6/77 level: I

skill title: Condenser Capacity Test

developed & written by: Jim Pitts

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

You are going to learn:

How to test a condenser for capacity using a mercotronic tester.

And in order to do this you will need:

Mercotronic tester

Condenser

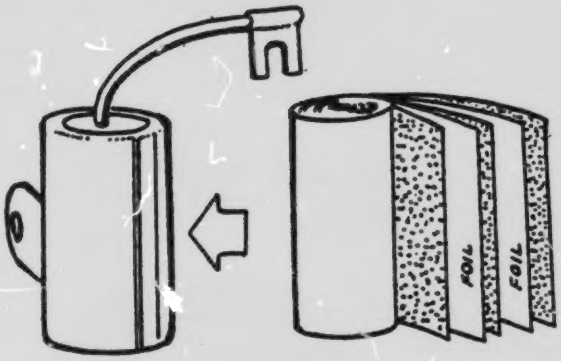
Mercotronic manual

We will know you can do it when:

You can test a condenser for capacity within manufacturers specifications using a mercotronic tester.

INFORMATION

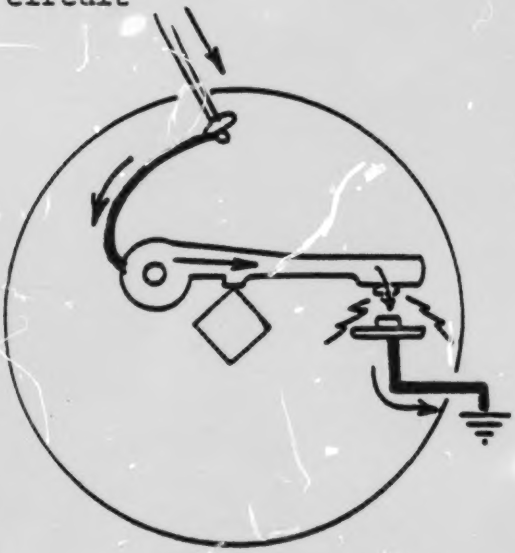
A condenser is made of many layers of aluminum foil insulated from each other by a tin-like substance. The layers of foil are rolled together into a tight cylinder and put into case.



INFORMATION

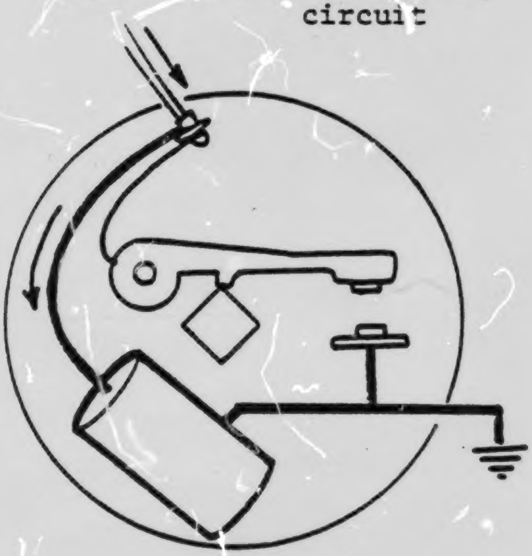
The condenser can store a small amount of electrical energy. The condenser absorbs the electric arc created when the points open. When the condenser absorbs the arc, the points do not burn up.

No condenser in Primary circuit



When contacts open, current continues to flow, causing an arc across contacts.

With condenser in Primary circuit



Condenser provides temporary place for primary current to go, reducing arcing at contacts.

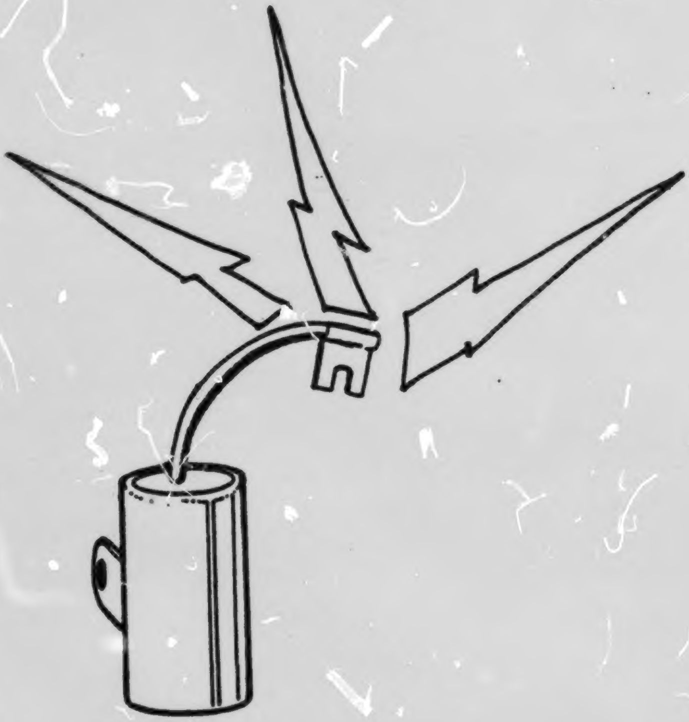
WORD GUIDE

ELECTRICAL ENERGY - Electric power.

DEFECTIVE - Faulty, not working well.

INFORMATION

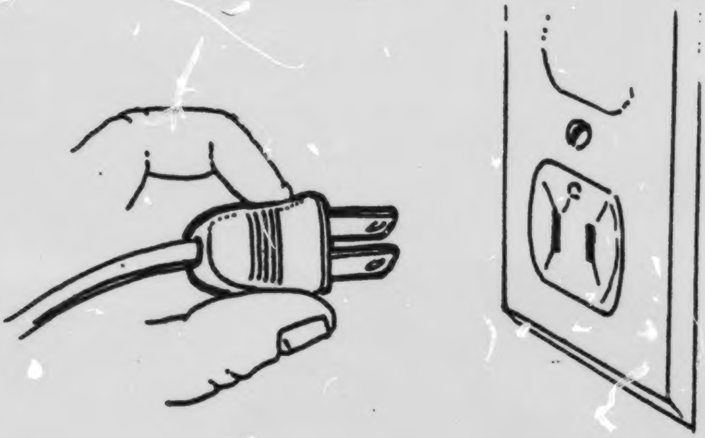
The next time the points close, the energy stored in the condenser flows through the points. When we test the condenser capacity, we check to see if the condenser is able to absorb the electrical energy. If it is defective, the breaker points will burn up.



JOB STEPS

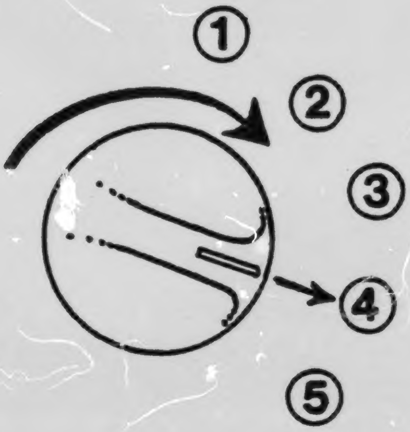
1. Get all equipment and go to your work area.

2. Plug the mercotronic tester into a 115 volt, electric outlet.



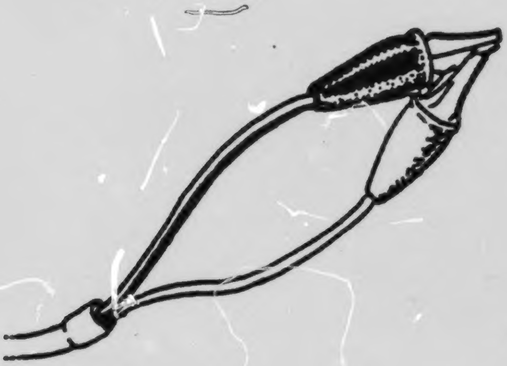
3. If the condenser is installed in an engine, put a piece of cardboard between the breaker points.

4. Put selector switch on position 4, (condenser capacity).

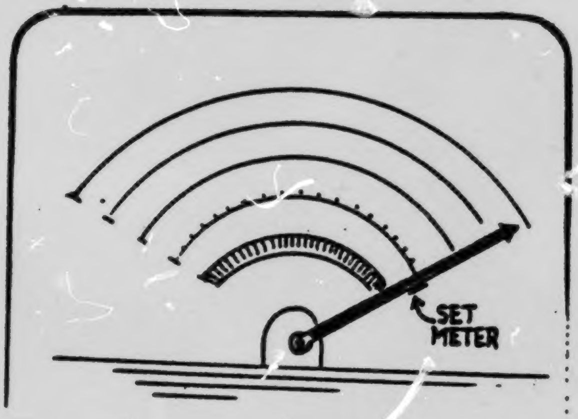


JOB STEPS

5. Clip small red and black test leads together.



6. Push red button down. Turn meter adjustment knob so that the needle is on the scale 4 set line on the right side of the meter.

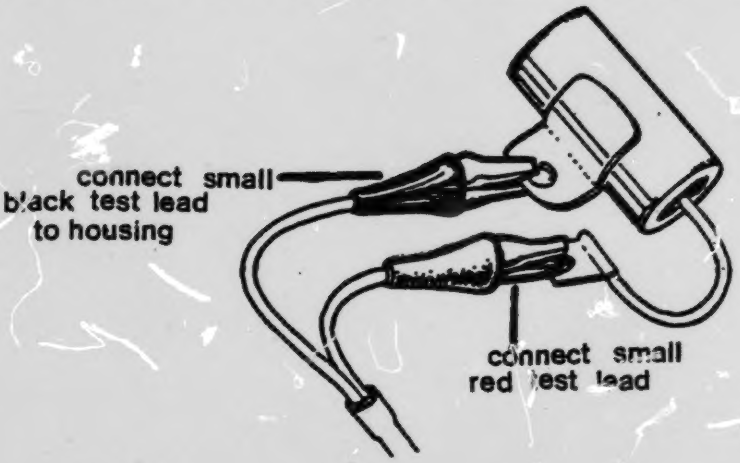


JOB STEPS

7. Unclip test leads.

8. Clip small red test lead to condenser lead.

9. Clip black test lead to condenser to hold down bracket.


connect small black test lead to housing
connect small red test lead

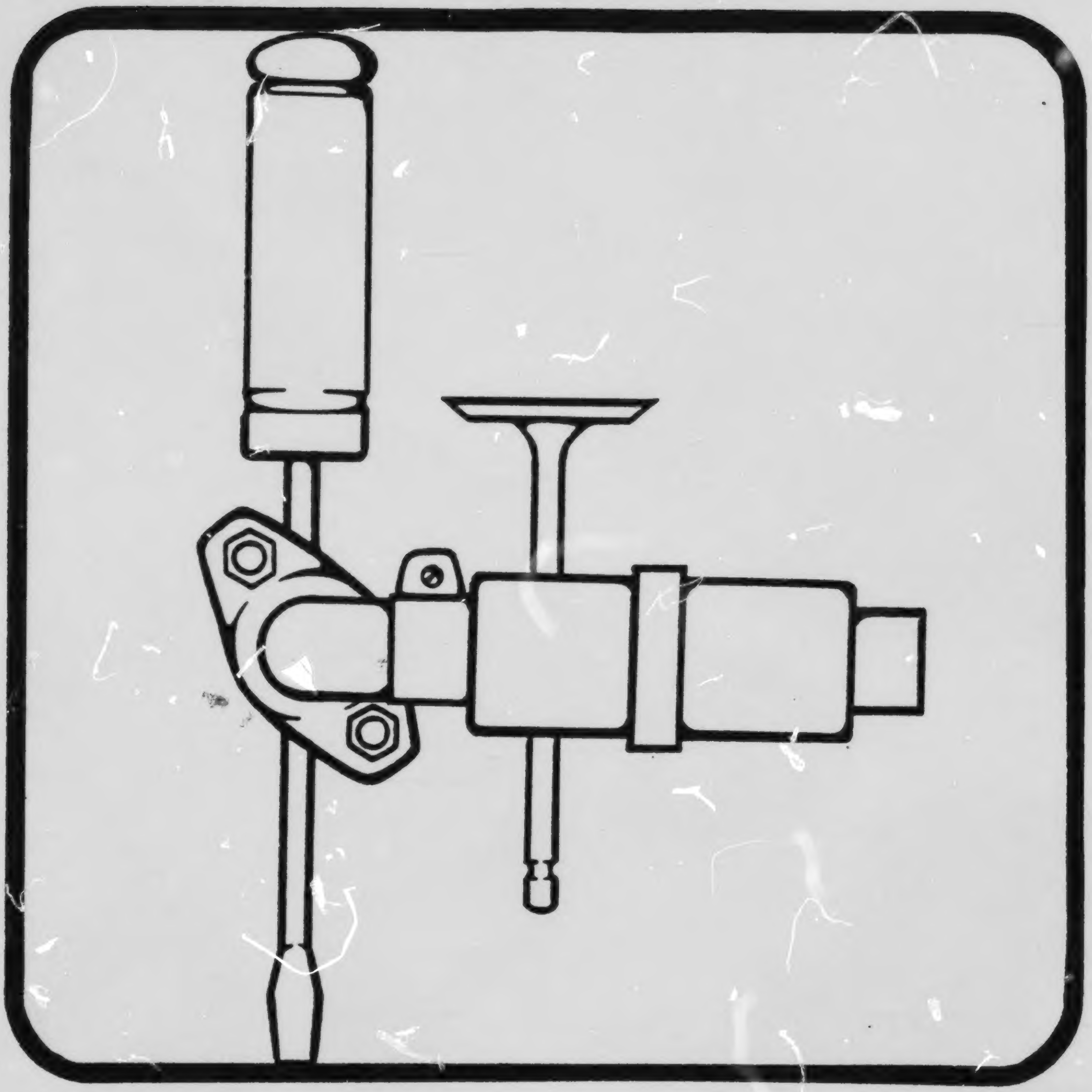
10. Push red button down and read scale 4.

11. A 294628 condenser should read 16-26 micro-farads (U.F.D.). If you have a different condenser, you will have to find its specifications in the mercotronic manual.

JOB STEPS

12. If the condenser does not pass this test, it must be replaced.

13. Have the instructor check your work.



small engine repair

unit: TEST EQUIPMENT

capital area career center

module: 7501 13 002 date: June 1977 level: I

skill title: Coil Power Test

developed & written by: Jim Pitts

visuals by: Dave Wehrwein and Bruce Bennett

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to test a coil with a mercotronic tester for power output and its ability to produce steady spark at high speed.

IN ORDER TO DO THIS YOU WILL NEED:

Engine with coil

Mercotronic tester

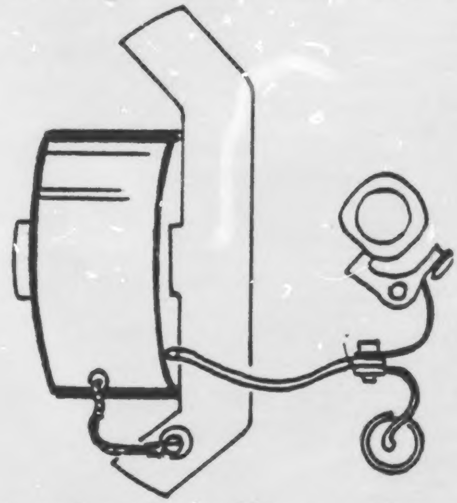
Mercotronic manual

WE WILL KNOW YOU CAN DO IT WHEN:

You have tested the coil for its rated output and for steady sparking, according to manufacturer's specifications.

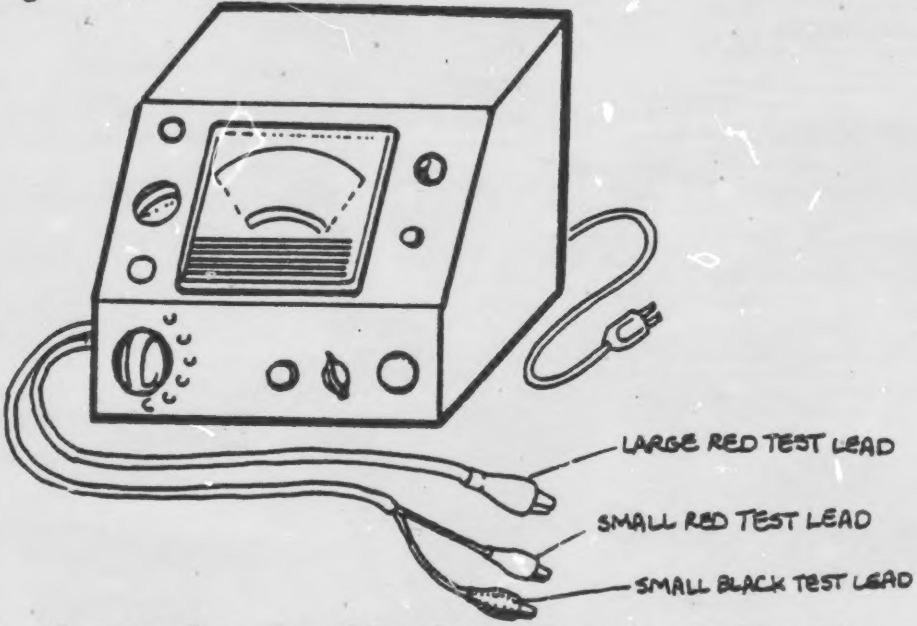
INFORMATION

A coil used on a small engine may look like this:



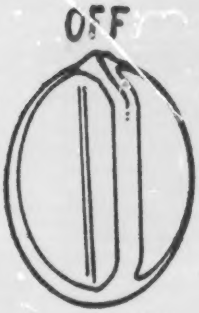
It is made of a core and two windings. The core is made so the coil can be bolted to the engine. One winding in the coil is primary and the other is secondary. Low current goes into the primary winding and high current comes form the secondary winding. The windings are insulated with a tar-like material.

To use the mercotronic tester for checking coil power, you need to know many things about the tester.

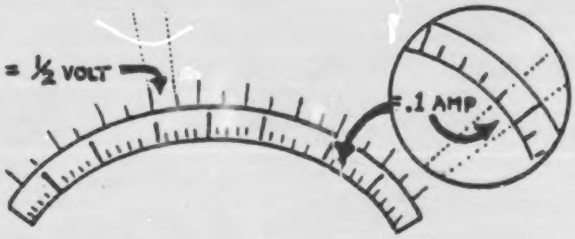


1. To check voltages from 0 - 24 volts. Use the small red (positive) and black (negative) clips.

2. Always check voltage on an engine with the selector switch "off".



3. Scale number 1 has 2 scales on it. The red numbers are for checking voltage. Each mark is 1/2 volt. The black scale is for checking amps.



Each mark is 1/10 of an amp. The scale will read up to 4 amps.

4. You do not need to remove the magneto from the engine to make these tests.

The specifications in this module are for a 298654 coil. If you have a different coil you will have to look up its specification in the mercotronic manual.

All coils should start to fire 1 to 3 marks before specified rating. If the coil starts firing only within specified rating, it is failing and should be replaced.

NOTE: When testing coils off stator plate, the laminated core must be in the coil.

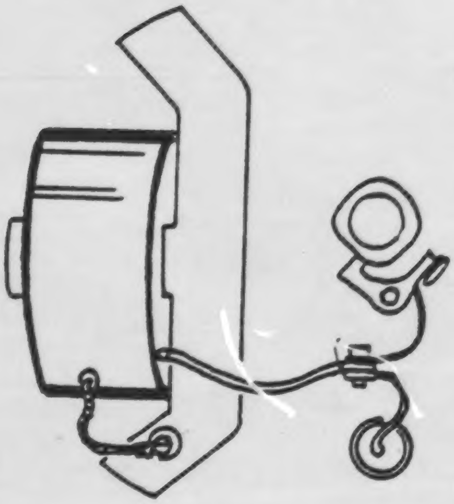
If you have a coil with 2 secondary windings, refer to page 23 in the Mercotronic Tester Manual.

WORD GUIDE

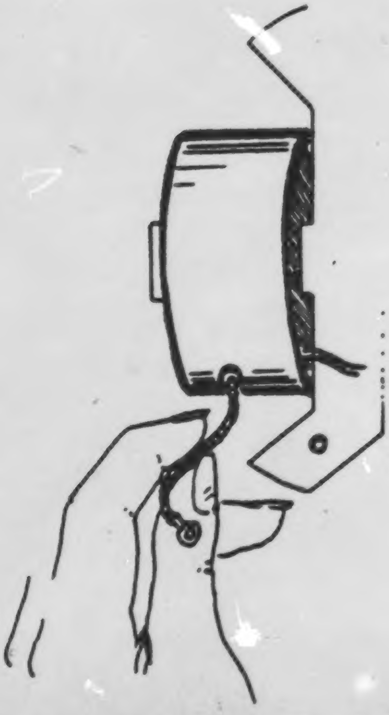
CLOCKWISE - To the right, in the
way as hands move on a clock

JOB STEPS

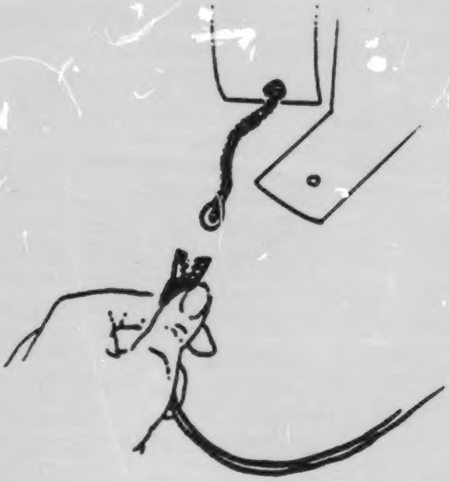
1. Get a magneto coil or an engine with a magneto coil on it. Then, plug the mercotronic tester into a 115 v. outlet.



2. Disconnect coil primary ground wire.



3. Clip small black test lead to coil primary ground wire.

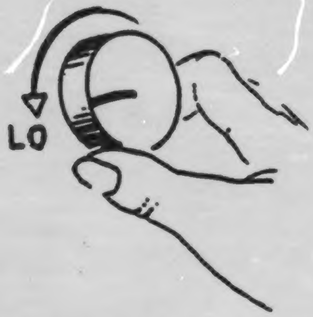


4. Disconnect the coil primary lead wire.

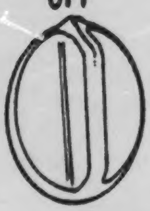
5. Clip small red test lead to coil primary lead.

6. Clip large red test lead to terminal of spark plug wire.

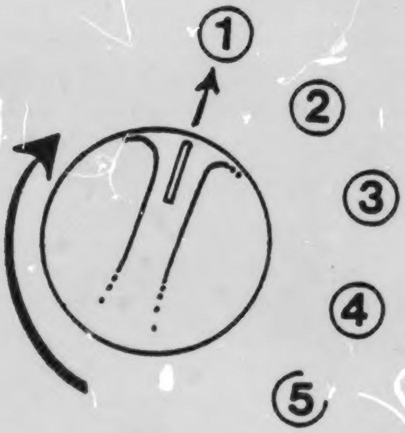
7. Be sure the current control knob is to the left, beyond the "LO" point.



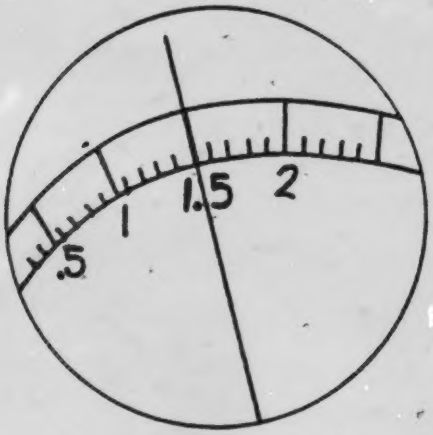
8. Turn volts scale switch "off".



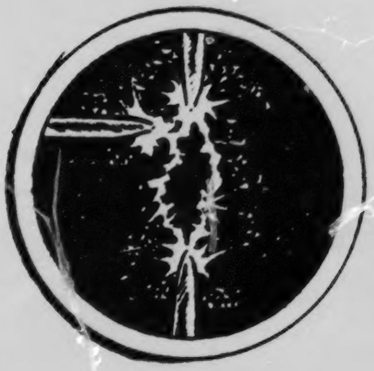
9. Turn selector switch to position #1: "Coil Power Test".



10. Turn the current control knob clockwise until the needle reads 1.5 amps on the black scale.



11. When the needle reads 1.5 amps, stop turning the current control knob. The 5 mm spark gap should make a steady spark.



12. If there is no spark or if the spark is faint or not steady, the coil is not good. The coil must be replaced.

13. If there is a steady spark, the coil is good. Now, perform the High Speed Test.

14. Quickly, turn the current control knob clockwise to get highest meter reading.

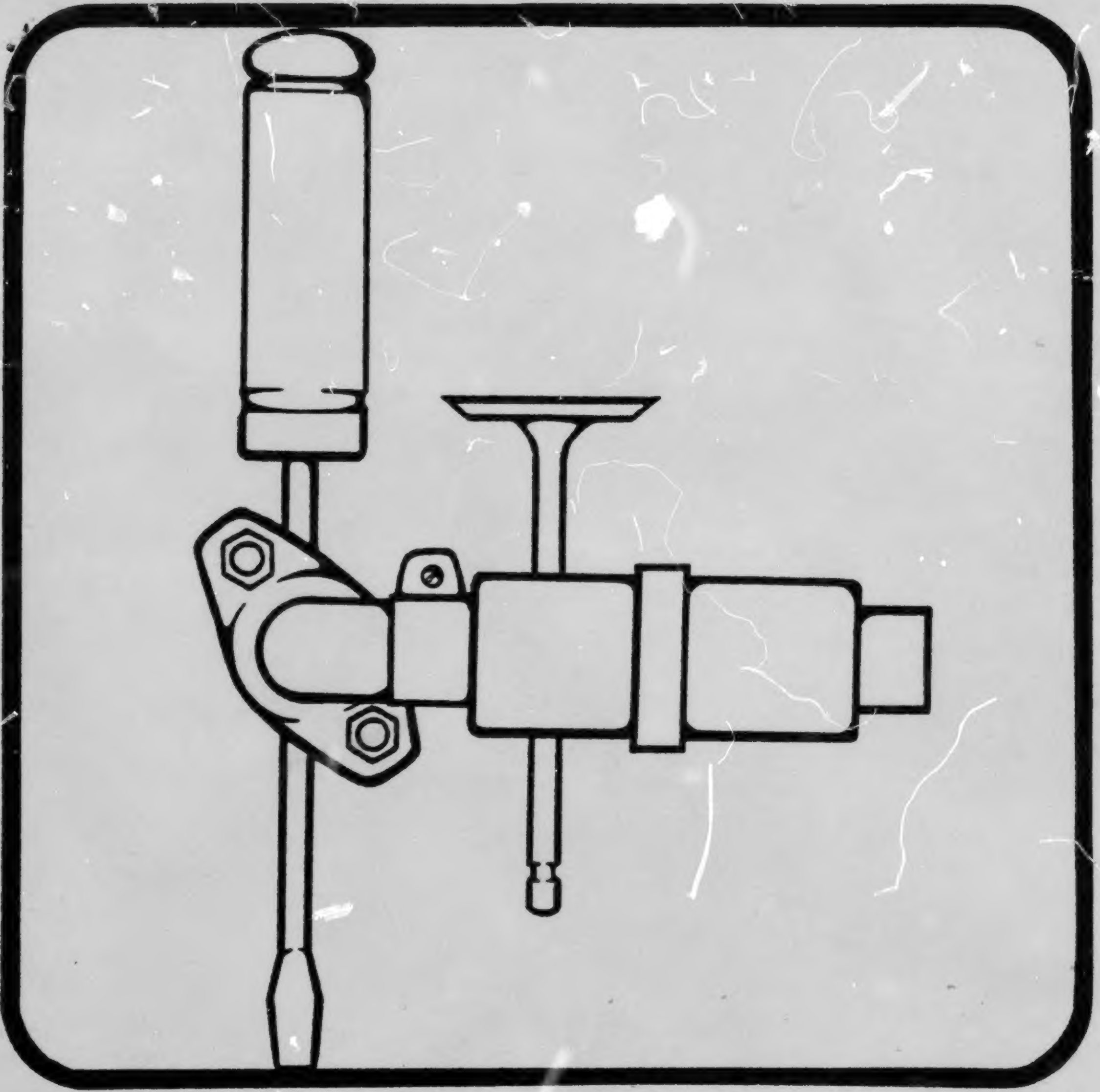
15. The spark gap should make a steady spark.

16. If there is no spark or if the spark is faint or not steady, the coil should be replaced.

17. As soon as you complete this test, turn off selector switch and current control knob.

18. Ask your instructor to check your work.

19. Remove the piece of cardboard from between the points.



small engine repair

unit: TEST EQUIPMENT

capital area career center

module: 7501 13 003 date: May 1978 level: I

skill title: Coil Surface Insulation Test

developed & written by: Jack Helder

visuals by:

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to test a coil for surface insulation defects on a 298654 coil.

IN ORDER TO DO THIS YOU WILL NEED:

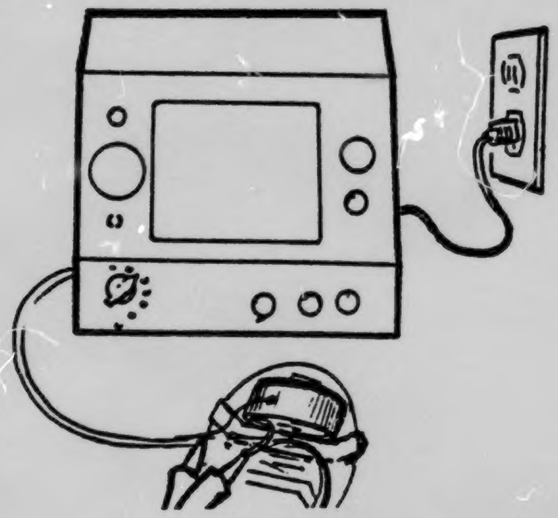
Coil - 298654
Mercotronic tester

WE WILL KNOW YOU CAN DO IT WHEN:

You have tested a 298654 coil for defects in surface insulation, according to service specifications.

INFORMATION

Insulation on some coils will break down or rot away. When this happens, the coil can short out because no current will go to the spark plug. You connect the meter to the coil like the picture below shows.

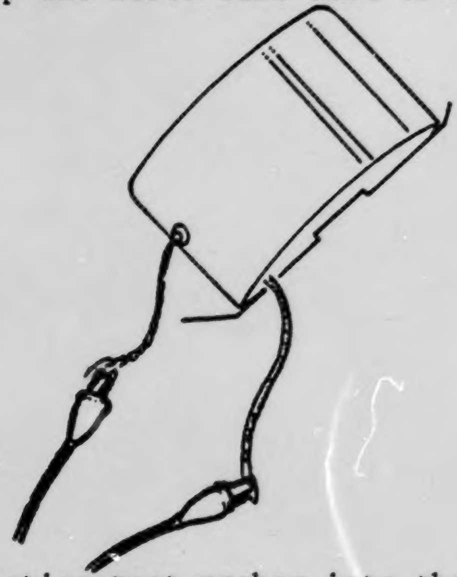


Sometimes, you see a faint spark around the coil insulation during the test. This is called a "corona" spark. This does not mean the coil is broken, rotten, or faulty. Be sure not to hold the test probe too long in one place.

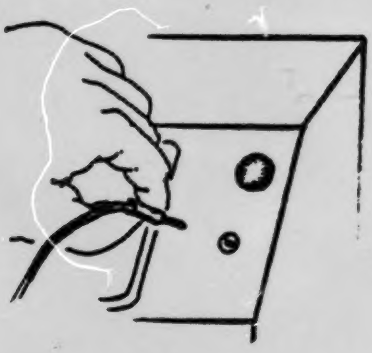
Complete this test as fast as you can.

JOB STEPS

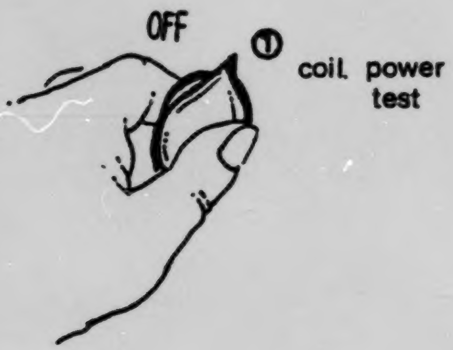
1. Get all equipment and go to your work area.
2. Plug mercotronic tester into 115 v. outlet.
3. Connect small red lead to coil primary lead or breaker point terminal. Clip the block test lead to coil primary ground wire.



4. Plug the insulation test prober into the "jack" on the front of the tester.

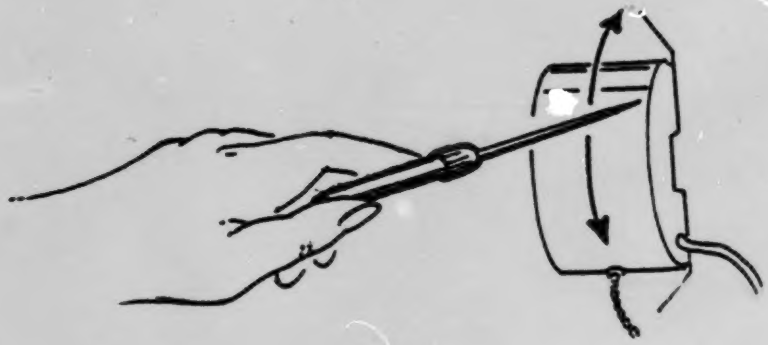


5. Turn the selector switch to #1, "Coil Power Test".



6. Turn current control knob to "high" and find maximum current reading. Do not turn the current control knob so the meter reads off the scale.

7. Pass the end of the insulation test probe over the insulated surface of the coil and spark plug wires.



8. If you see a spark discharge, the insulation is cracked.

9. Turn the current control knob to the "LD" position.
10. Turn the selector switch to "off".
11. Discuss the test results with your instructor.

small engine repair

unit: TEST EQUIPMENT

capital area career center

module: 7501 13 005 date: 6/77 level: I

skill title: Dynamometer - Mark II

developed & written by: Jim Pitts

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

You are going to learn:

How to test a snowmobile on the Mark II dynamometer.

And in order to do this you will need:

A snowmobile that runs

A dynamometer

We will know you can do it when:

You have tested a snowmobile on the dynamometer to be sure it runs according to service manual specifications.

INFORMATION

The Mark II dynamometer is a device designed to test a snowmobile under very cold conditions.

When you put the snowmobile on the dynamometer, be sure that the drive track does not overlap either end of the dynamometer.

WORD GUIDE

ADVANCE - Move forward.

JOB STEPS

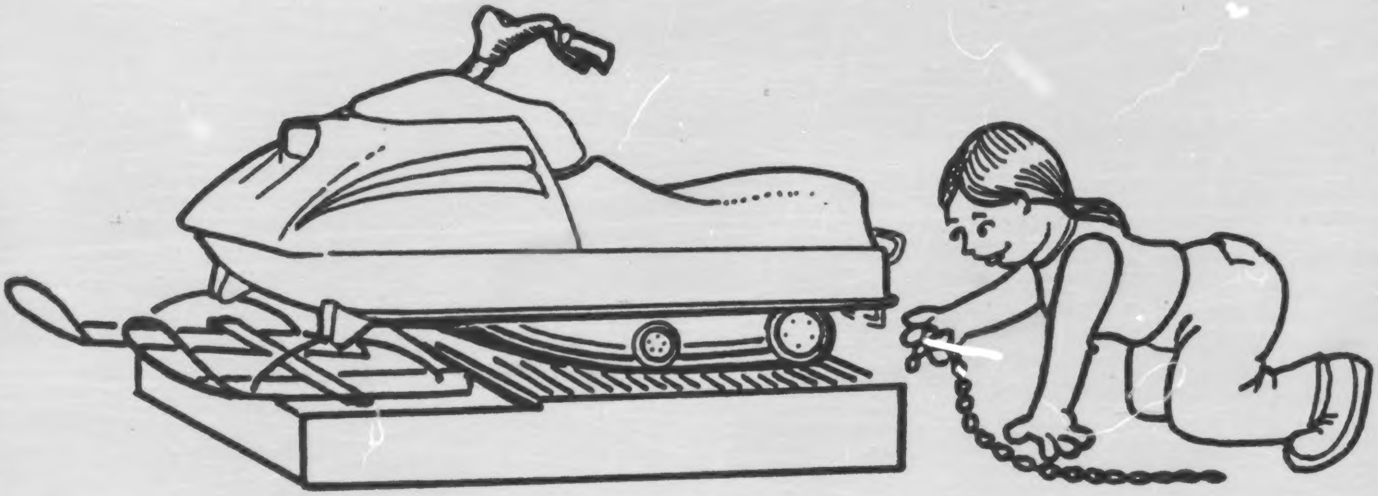
1. Go to your work area and ask your instructor to show you which snowmobile to use.

2. Check the oil and gas levels in the snowmobiles.

3. Check the oil level in the dynamometer by taking the oil cap off and checking to see if the oil tank is full.

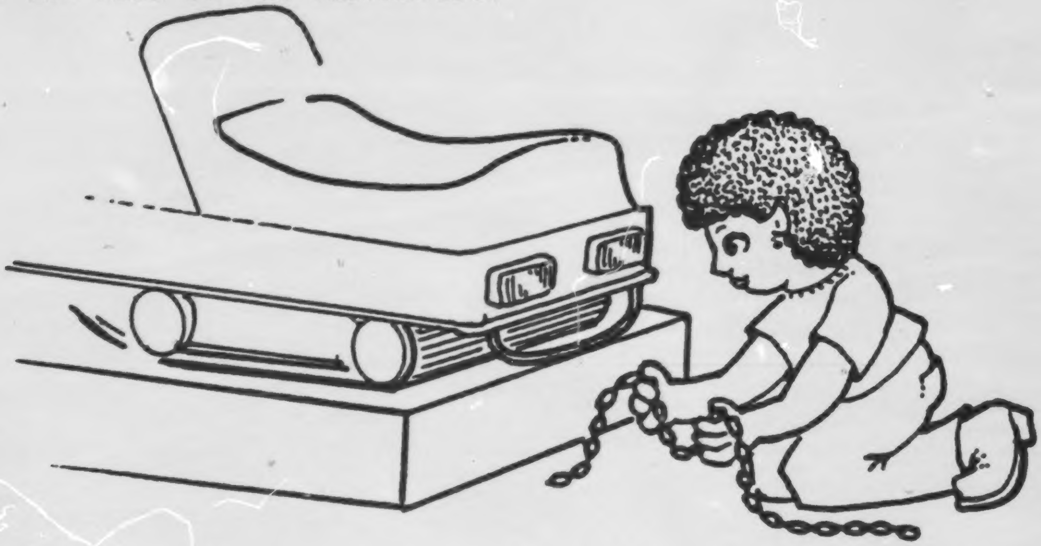
4. Ask your instructor or another student to help you put the snowmobile onto the dynamometer.

5. Chain down the snowmobile.



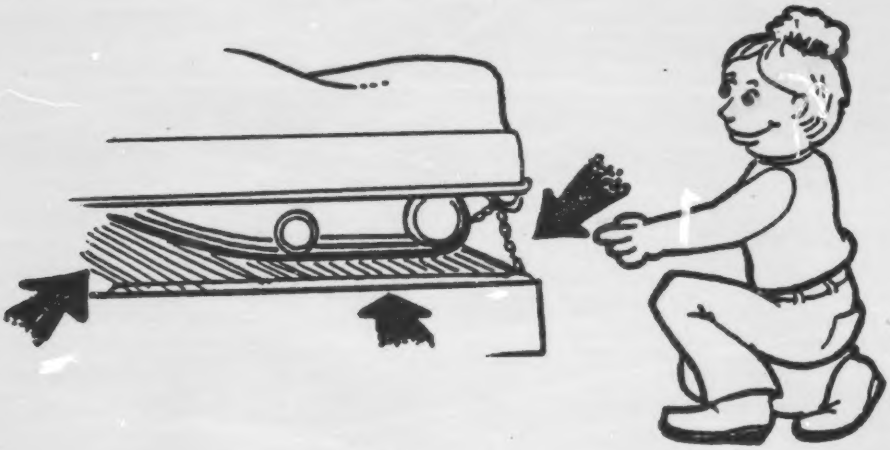
JOB STEPS

6. Attach the retaining bar and the down chain to the tow bar at the rear of the snowmobile.



7. Start the snowmobile engine and sitting on the machine, slowly advance the throttle.

8. Check the snowmobile to be sure the track is not touching any of the still front on the dynamometer. Be sure to check the front, back and both sides.



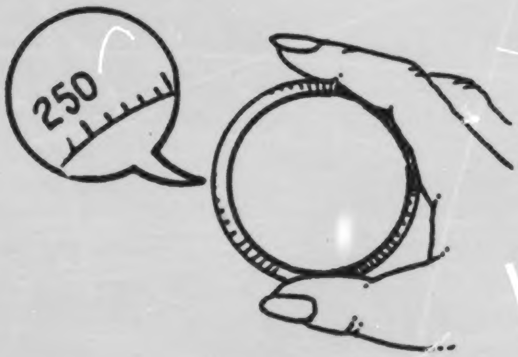
WORD GUIDE

CLOCKWISE - To the right.

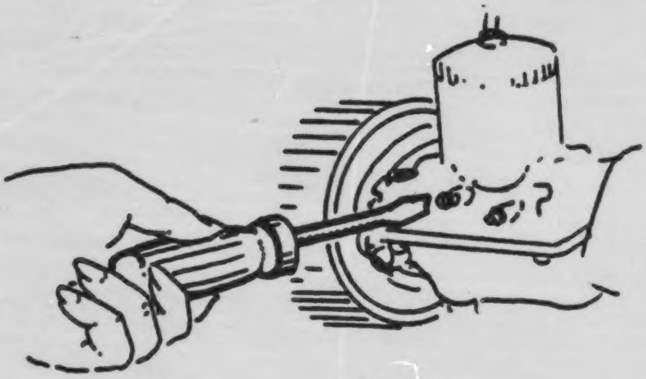
JOB STEPS

9. Advance the throttle to full speed.

10. Turn the pressure control knob on the dynamometer clockwise until it reads 250 pounds.



11. Adjust the high speed needle on the snowmobile carburetor.



JOB STEPS

12. Watch the speedometer. Turn the needle in or out until it reaches the highest speed.

    NOTE: Do not turn out the high speed needle less than 1½ turns. When you are finished adjusting the needle, the speed should stay steady.

13. Turn the pressure control knob to 500 pounds pressure. Check the speedometer to see that the speed stays steady.

14. Shut off the dynamometer pressure control and slow the snowmobile to idle.

15. Shut off the snowmobile.

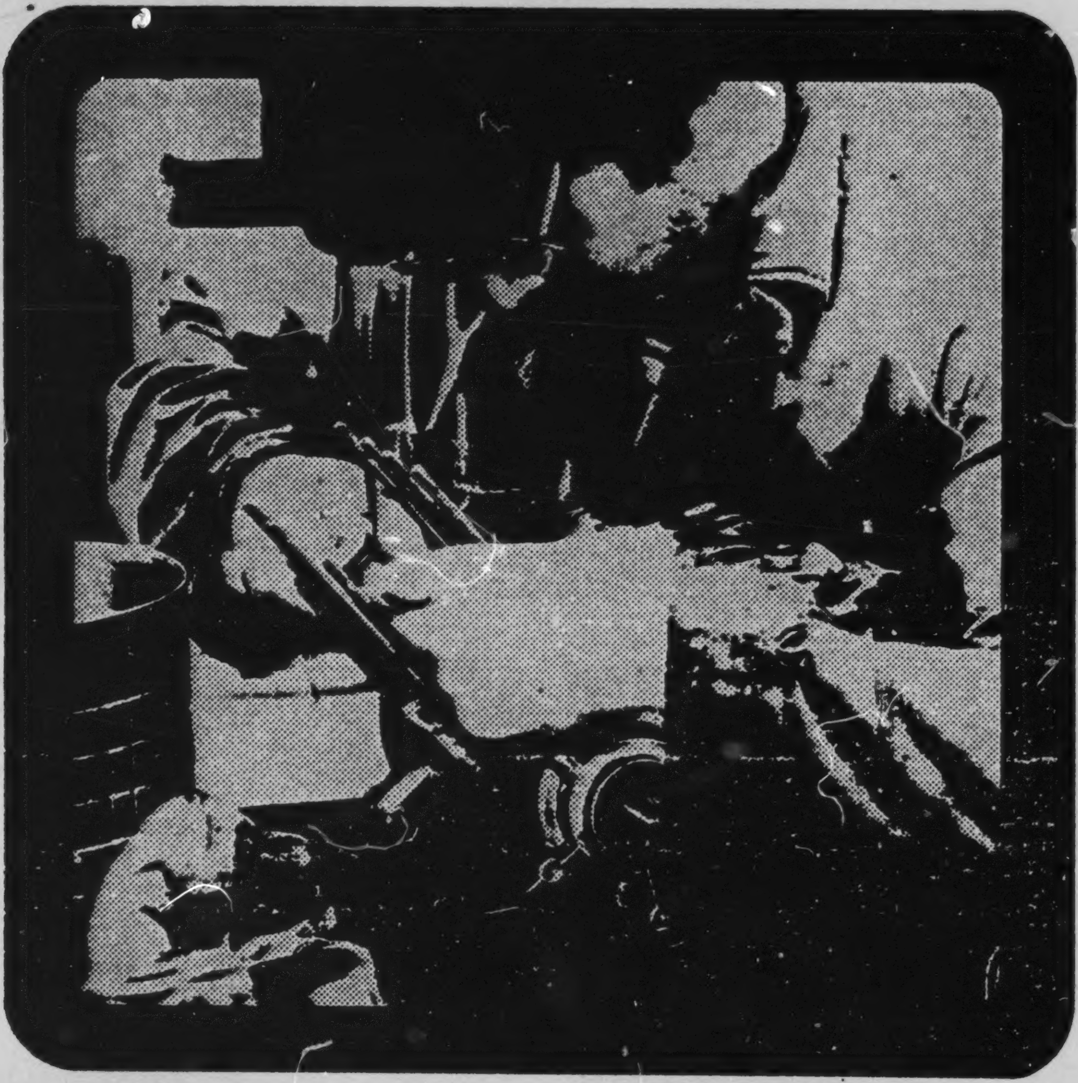
16. Remove the tie-down chain and retaining bar.

17. Remove the hold chains.

18. Ask someone to help you lift the snowmobile off the dynamometer.

19. Clean the snowmobile so it can be delivered to the customer.

31-A



small engine repair

unit: TEST EQUIPMENT

capital area career center

module: 7501 13 006 **date:** June 1977 **level:** I

skill title: Condenser Leak and Shortage Test

developed & written by: Jim Pitts

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

You are going to learn:

How to test a condenser with a mercotronic tester for leaks and shorts.

And in order to do this you will need:

Condenser

Mercotronic tester

We will know you can do it when:

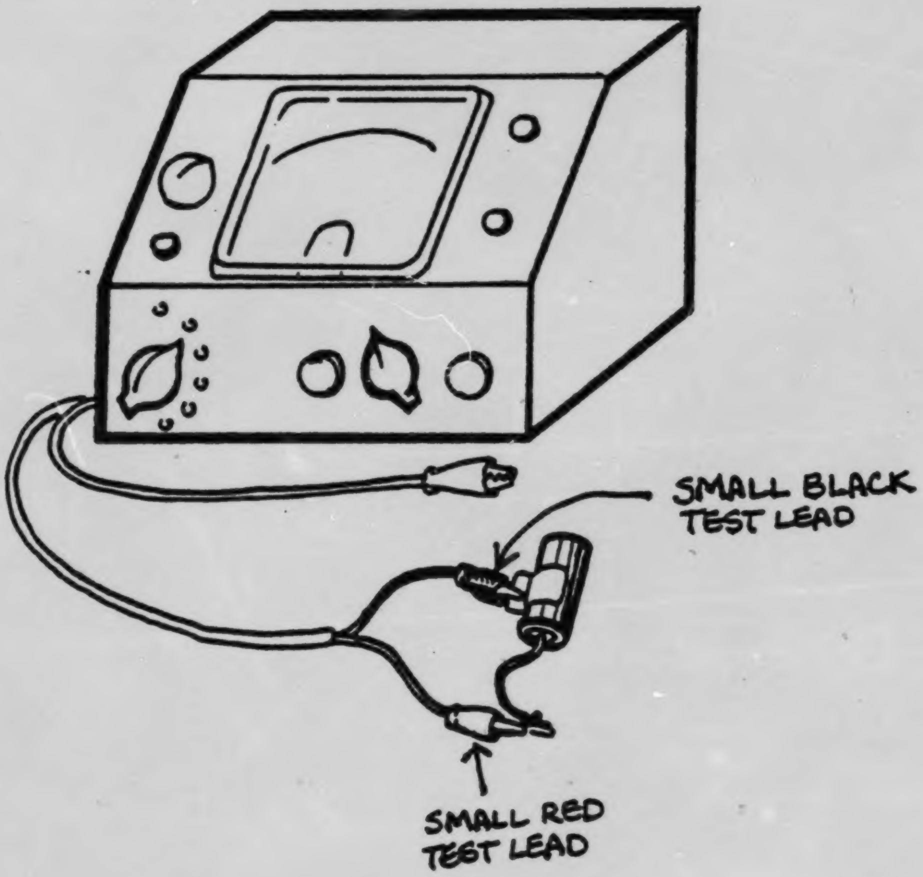
You have tested the condenser with a mercotronic tester for leaks or shorts (according to service specifications).

INFORMATION

You are going to test a condenser for leaks or shorts. In either case, the condenser will not work properly. This will cause the points to burn up and the engine to quit running. For this test, you can have the condenser either on or off the magneto.

You must remove the condenser lead from the breaker point terminal. The condenser should be taped against an insulated board so a loose element condition will not show up.

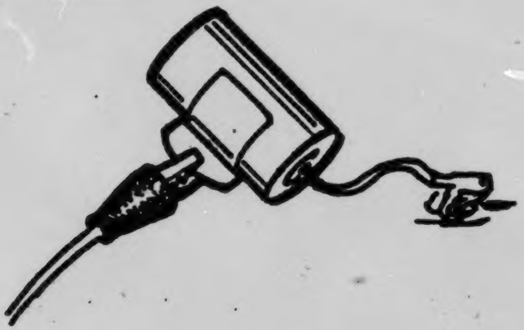
The tester is connected to the condenser as shown in the picture below.



JOB STEPS

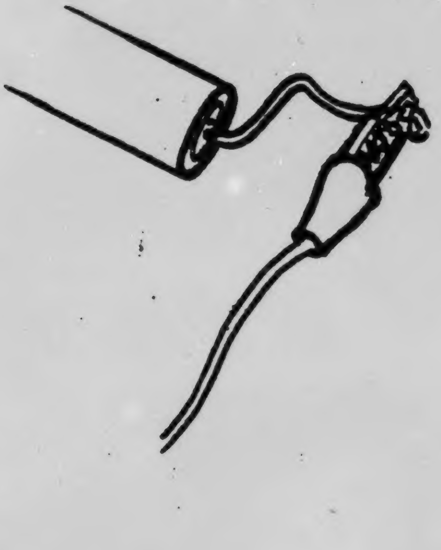
1. Get all equipment and take it to your work area.

2. Clip the small black test lead to the stator plate or body of the condenser.



3. Remove the condenser lead from the breaker terminal.

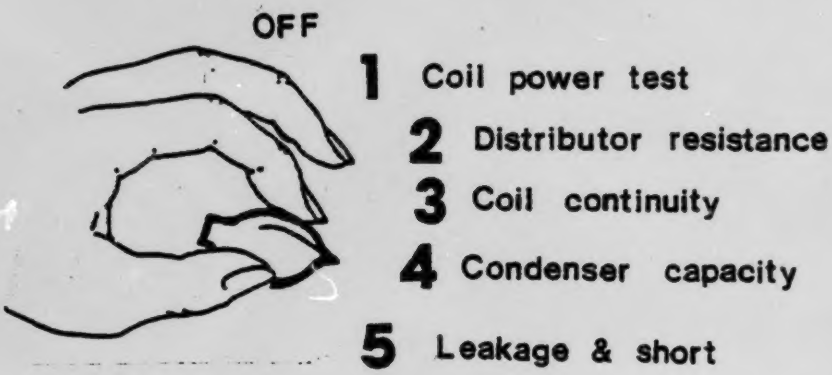
4. Clip the small red test lead to the condenser lead.



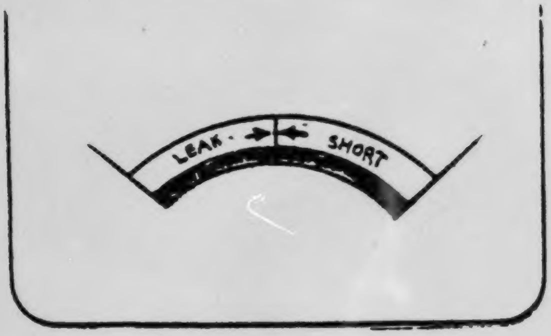
JOB STEPS

5. Plug the tester into a 115v outlet.

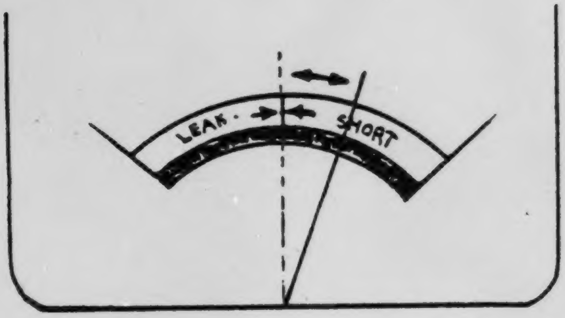
6. Turn selector switch to #5 "leakage" and short position.


OFF
1 Coil power test
2 Distributor resistance
3 Coil continuity
4 Condenser capacity
5 Leakage & short

7. Look at scale #5 on the mercotronic.



8. Then, push down the red button and hold it down at least 15 seconds. The pointer should move to the right, then back to "0" within 15 seconds. If the hand doesn't come back to "0", but stays above "0" the condenser is leaking and must be replaced.



JOB STEPS

9. Let go of the button, the meter pointer should move to the right and then back to the zero line.

   NOTE: If your tests do not go as in steps 8 and 9, the condenser is bad.

10. Turn the test selector to "off".

11. Ask your instructor to check your work.

small engine repair

unit: TEST EQUIPMENT

capital area career center

module: 7501 13 007 **date:** June 1977 **level:** I

skill title: Condenser Series Resistance Test

developed & written by: Jim Pitts

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

You are going to learn:

How to test a condenser for series resistance using a mercotronic tester.

And in order to do this you will need:

Condenser

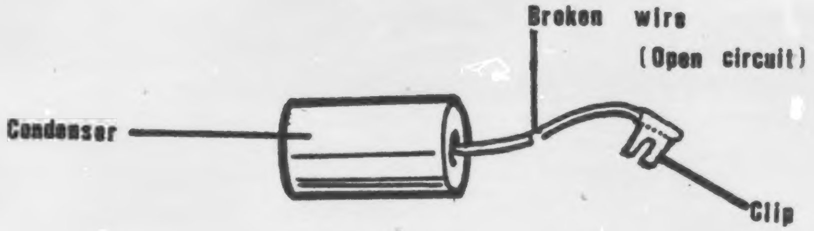
Mercotronic tester

We will know you can do this when:

You have tested a condenser with a mercotronic tester to see if it has series resistance, according to service specifications.

INFORMATION

Series resistance is an open circuit within the condenser. Current will not flow through an open circuit.



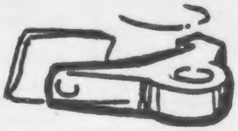
If a connection is loose, it can create an open circuit because of vibration from the running engine. This test can also tell you if the condenser will charge or discharge (see module 7501 13 001).

Since this is a very sensitive test, be sure the meter clips and condenser are clean.

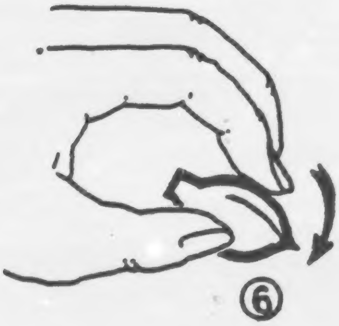
JOB STEPS

1. Get all equipment and go to your work area.

2. If the condenser is on a magneto, leave cardboard between the breaker points.

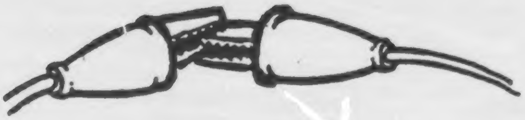


3. Put selector switch on position #6 "condenser series resistance". (See picture below).



JOB STEPS

4. To set the meter, clip the small block and red test leads together.

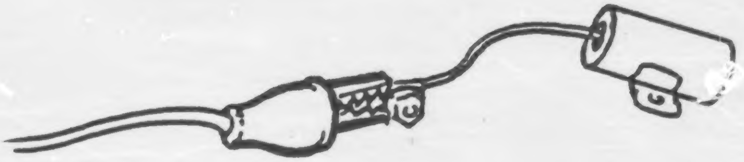


5. Plug the tester into a 110v outlet.

6. Adjust the meter set scale 6 to set line on right side of scale.

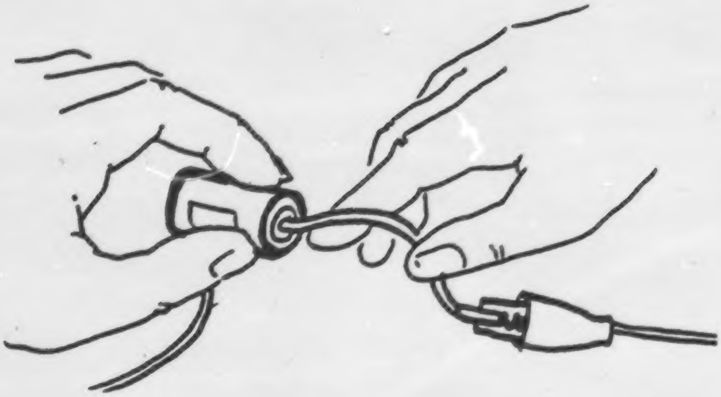
7. Unclip the test leads.

8. Clip small red test lead to breaker terminal or loose condenser lead.

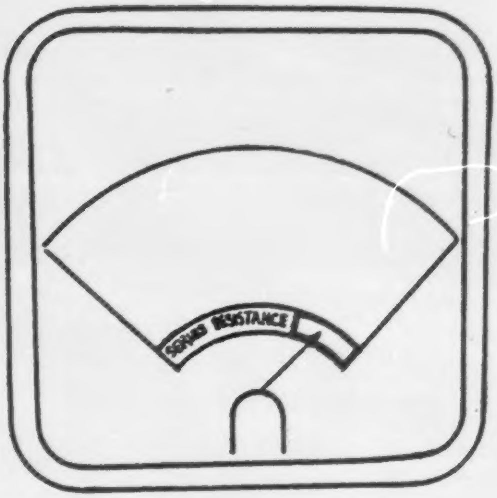


JOB STEPS

9. Clip small black test lead to stator plate or body of condenser.



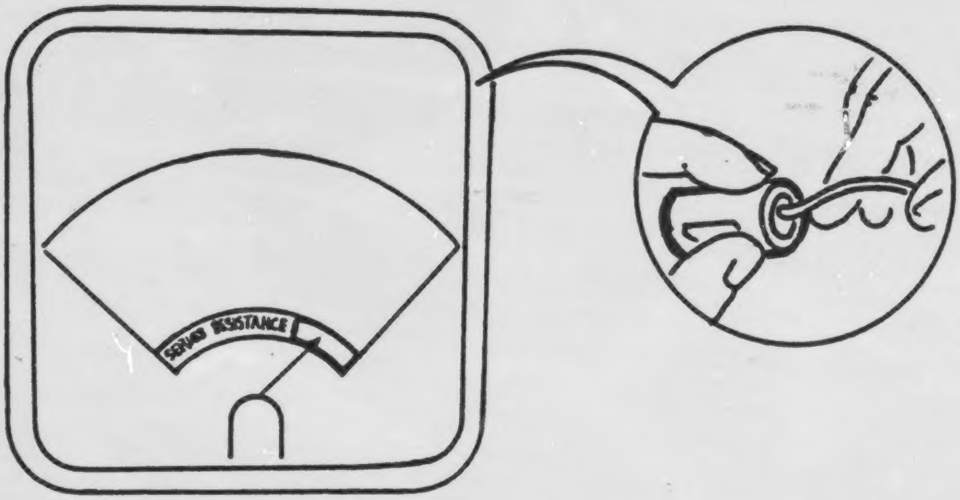
10. Meter pointer must be within ok green block on scale #6.



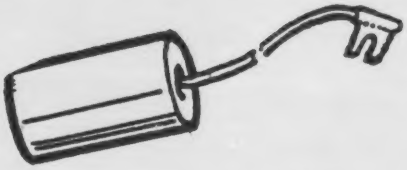
SERIES RESISTANCE

JOB STEPS

11. When testing, wriggle the lead coming out of the condenser. Look for movement in the meter needle.


SERIES RESISTANCE

12. If there is any movement, the condenser lead is "open".

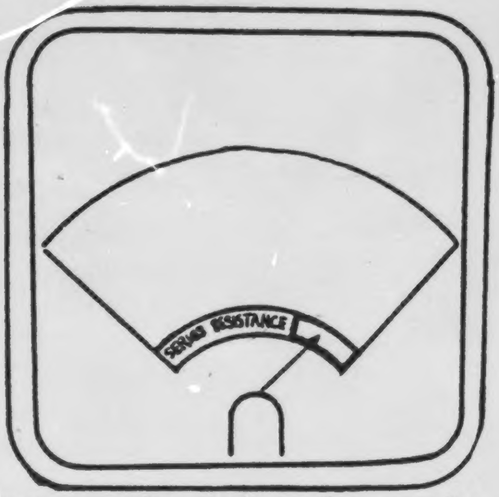


WORD GUIDE

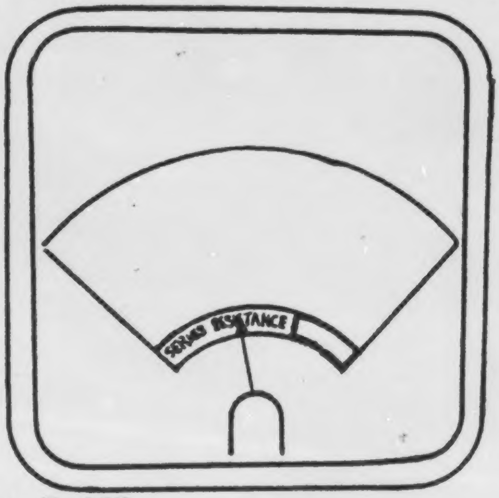
DEFECTIVE - Faulty, failing, not working.

JOB STEPS

13. If the needle stays within the green zone on the scale, the condenser is alright.


SERIES RESISTANCE

14. If the meter pointer moves to the red scale on the meter, the condenser is defective.


SERIES RESISTANCE

15. Turn the test selector to "off".

16. Ask your instructor to check your work.

small engine repair

unit: Test Equipment

capital area career center

module: 7501 13 008 **date:** 6/77 **level:** I

skill title: Primary Resistance Test

developed & written by: Jim Pitts

visuals by:

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to measure resistance in the coil using a mercotronic tester.

IN ORDER TO DO THIS YOU WILL NEED:

Coil
Mercotronic Tester
Mercotronic Tester Manual

WE WILL KNOW YOU CAN DO IT WHEN:

You have tested the coil for resistance according to service specifications using a mercotronic tester.

WORD GUIDE

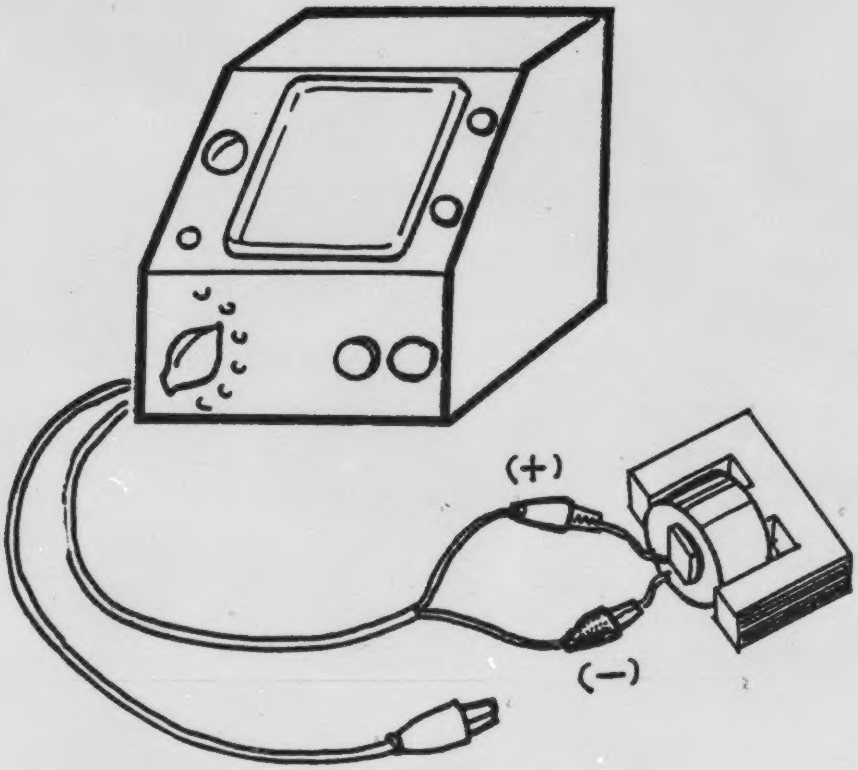
PRIMARY - First

INFORMATION

Resistance is measured in ohms. One ohm is one unit of resistance. Any resistance stops the flow of current.

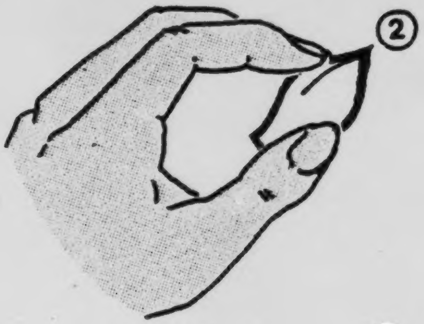
You are going to check the coil to see if there is resistance to the flow of current in the primary winding of the coil. (See mod 7501 13 002) Maximum resistance is a complete open circuit (See mod 7501 13 007). If the meter does not read within the specified limit, then the coil must be replaced.

Hook up the tester as in the picture below.

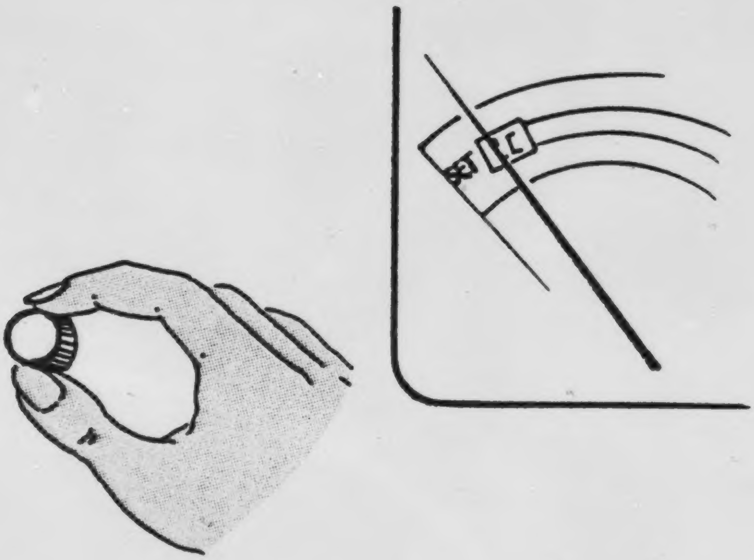


JOB STEPS

1. Get all equipment and take it to your work area.
2. Turn selector switch to position #2 (Distributor Resistance). You can now check low ohm resistances.

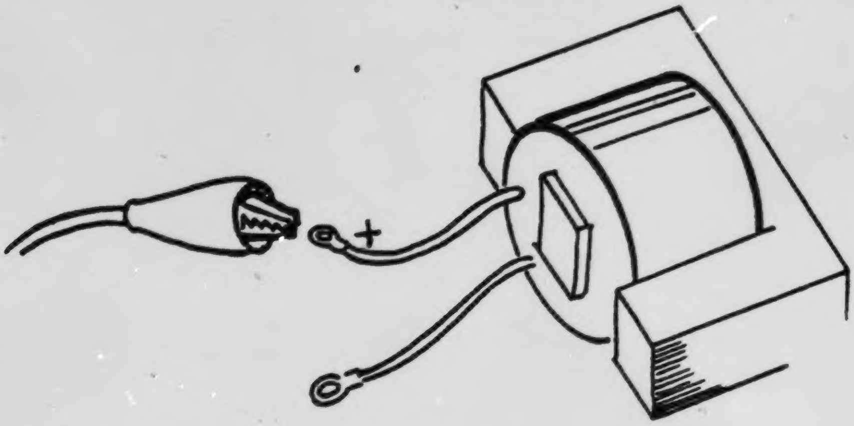


3. Turn meter adjustment knobs for scale #2 until the meter needle lines up on the set position on the left side of scale #2. You can now check resistances of 0-30 ohms.

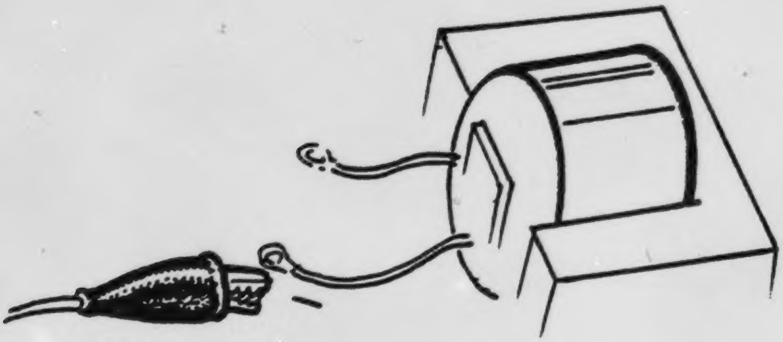


JOB STEPS

4. Clip small red test lead to primary (positive) side of coil.



5. Clip small black test lead to negative side of coil.



6. Read scale #2 result.

7. For the 298654 coil, the needle should be between 18 - 24 ohms. (Read the red numbers.)

   NOTE: If you have a different coil, you must look up the specifications in the mercotronic manual.

8. If the reading is below 18 ohms, the primary winding is shorted.

9. If the reading is above 24 ohms, the winding is open.

10. Turn the test selector to "off".

11. Ask the instructor to check your work.

small engine repair

unit: TEST EQUIPMENT

capital area career center

module: 7501 13 009 date: June 1977 level: I

skill title: Coil Continuity Test

developed & written by: Jim Pitts

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

You are going to learn:

How to test a coil with a mercotronic tester for continuity of windings.

And in order to do this you will need:

Mercotronic tester

Mercotronic tester manual

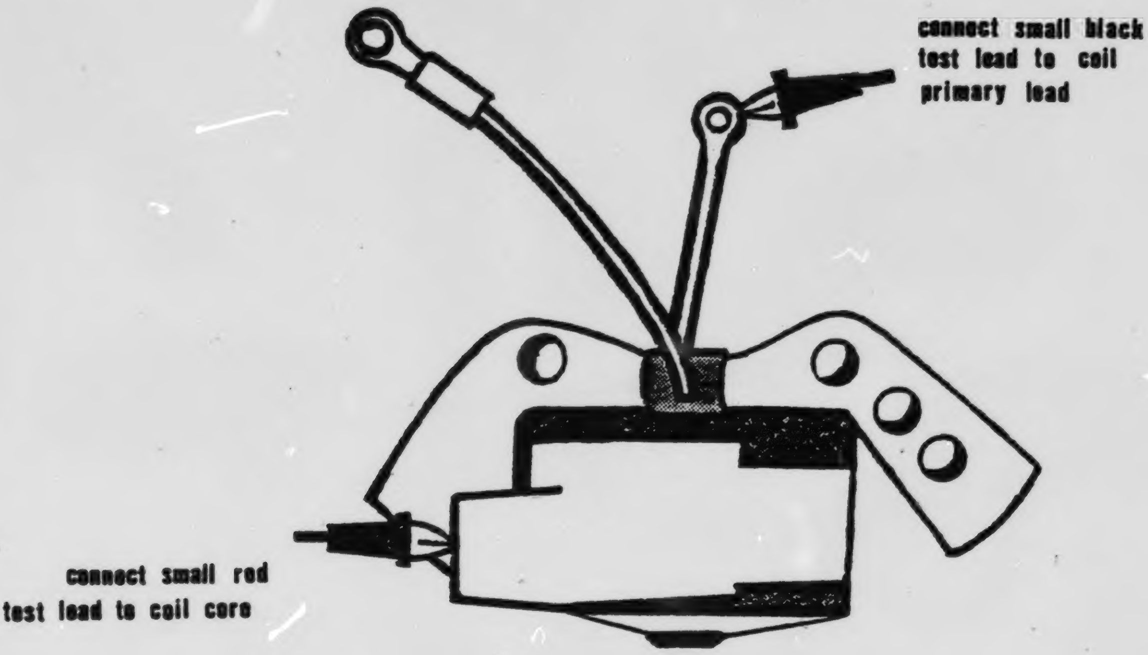
Coil

We will know you can do it when:

You have tested the coil for continuity, according to service specifications, using a mercotronic tester.

INFORMATION

The coil secondary winding must be tested for opens or shorts. If the coil is defective, no current will go to the spark plug. If this is the case, it must be replaced. Connect the meter as shown below. For a review of resistance, see module 7501 13 008.


connect small black test lead to coil primary lead
connect small red test lead to coil core

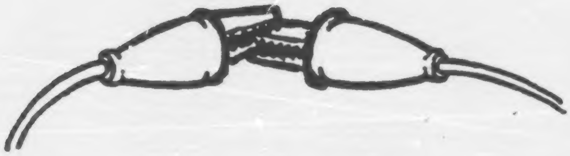
R

JOB STEPS

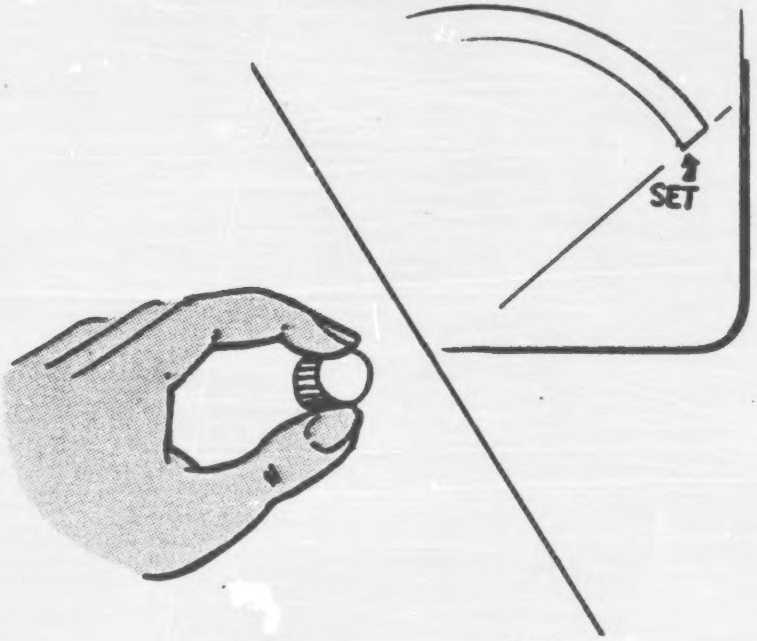
1. Get all the equipment and go to the work area.

2. Turn selector switch to position #3 (coil continuity).

3. Clip together small red and black test leads.

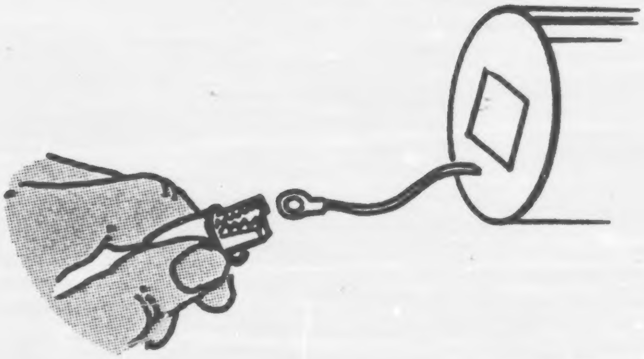


4. Zero meter by turning scale 3 adjustment knob. The meter is set when the needle is on scale 3 (right side) set line.

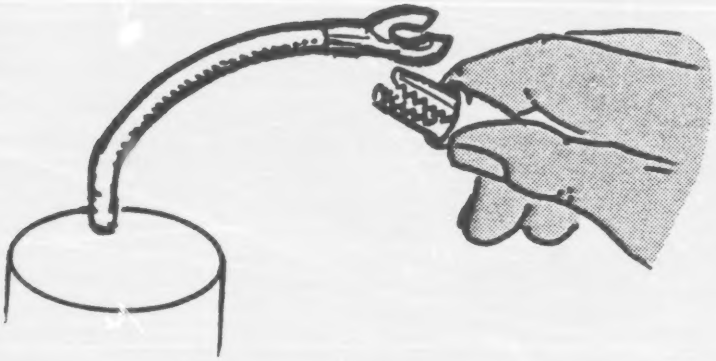


JOB STEPS

5. Unclip leads and clip small black test lead to coil ground wire.



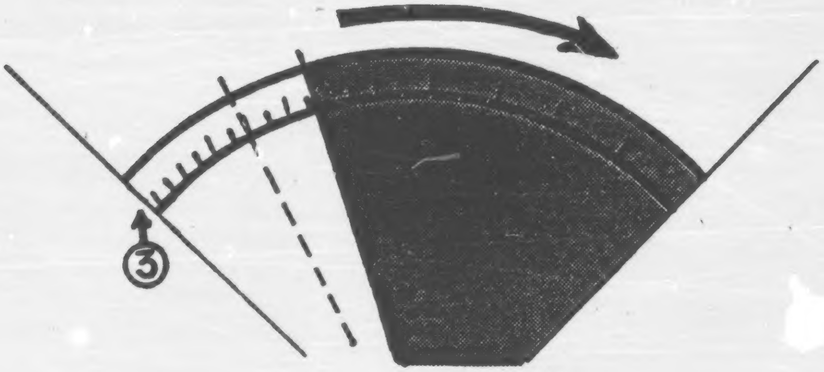
6. Clip small red test lead to spark plug high tension lead.



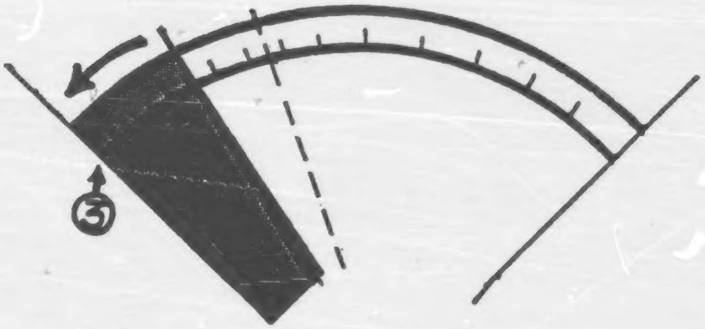
7. The meter should read between 25-35 ohms. (Bottom numbers on scale). If you do not have a 298654 coil, look up the resistance valves in the mercotronic manual.

JOB STEPS

8. Readings lower than 25 ohms mean the coil is shorted.



9. Readings above 35 ohms mean the coil secondary-winding is open.



10. If the coil is defective, it must be replaced.

11. Turn the selector switch "off" and ask your instructor to check your work.

small engine repair

unit: Motorcycle

capital area career center

module: 7501 14 001 **date:** 4-18-77 **level:**

skill title: Timing a Single Cylinder (Flywheel Covering Points) Magneto System Only

developed & written by: Don Foster

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

You are going to learn:

How to set points and time the engine.

And in order to do this you will need:

Hand tools

Buzz box

Timing light

Dial indicator

Manufacturer's manual

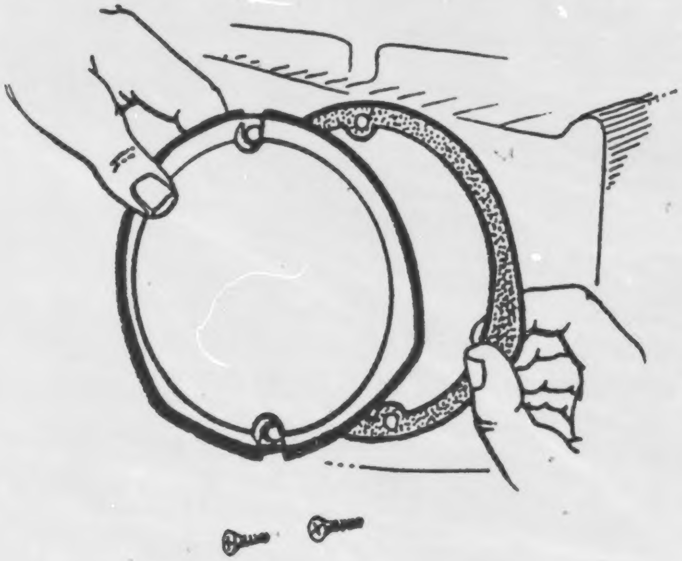
One-cylinder engine flywheel covering the points

We will know you can do it when:

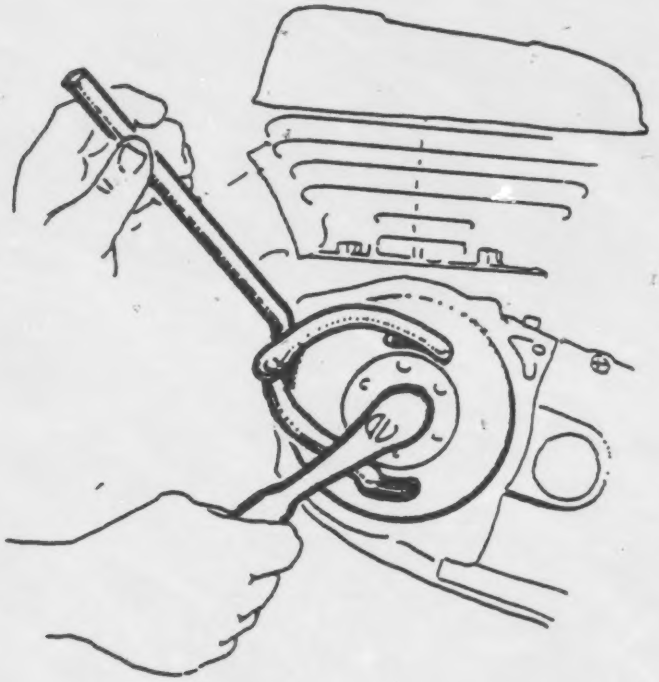
1. You have set not more than ± .002 off manufacturer's specifications by using the buzz and dial indicator.
2. You line up the "hash" marks on the rotor, using a timing light, while the engine idles.
3. You line up the hash marks on the rotor line up while the engine runs at 4,000 R.P.M.

JOB STEPS

1. Using Phillips screwdriver, remove the side case that covers the magneto (usually on the left side).

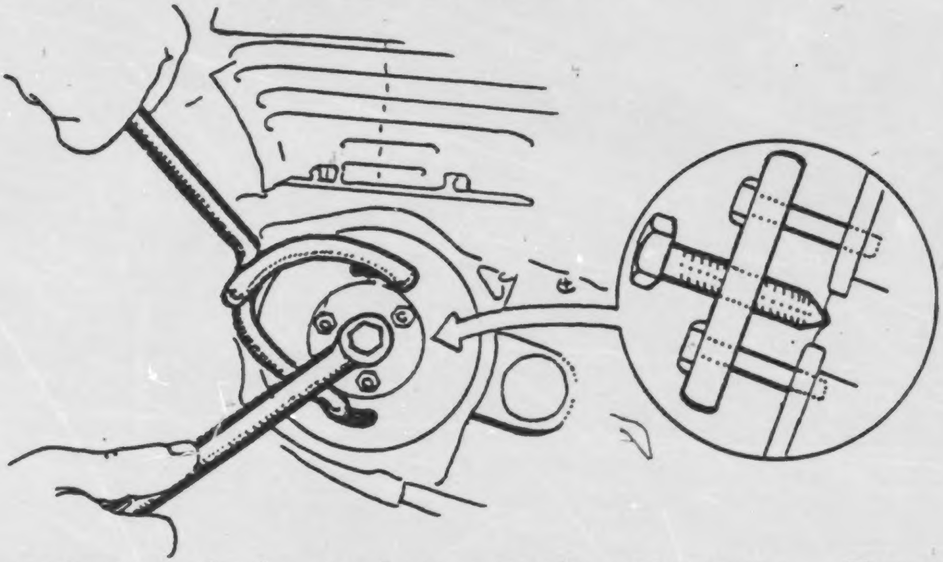


2. Using flywheel wrench and metric socket, remove the flywheel by holding it with the flywheel wrench and taking off the holding nut.



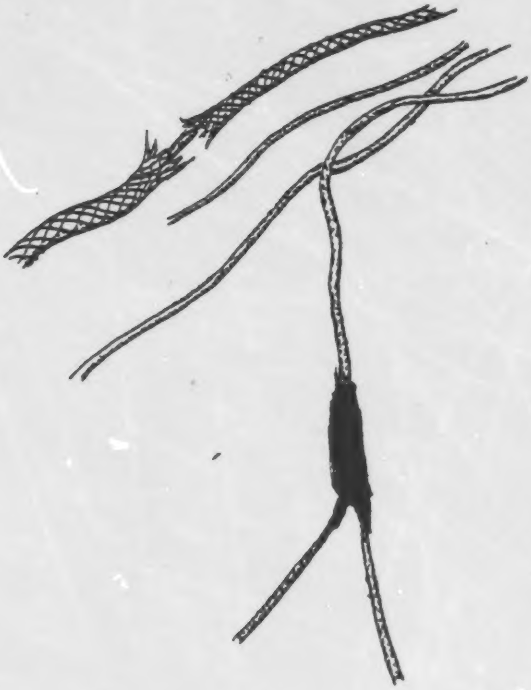
JOB STEPS

3. Again use a flywheel wrench to keep the flywheel from turning, use a puller to pull the flywheel free.



4. Use compressed air to clean out the point area. Then, run a piece of stiff paper or cardboard through the points to clean them.

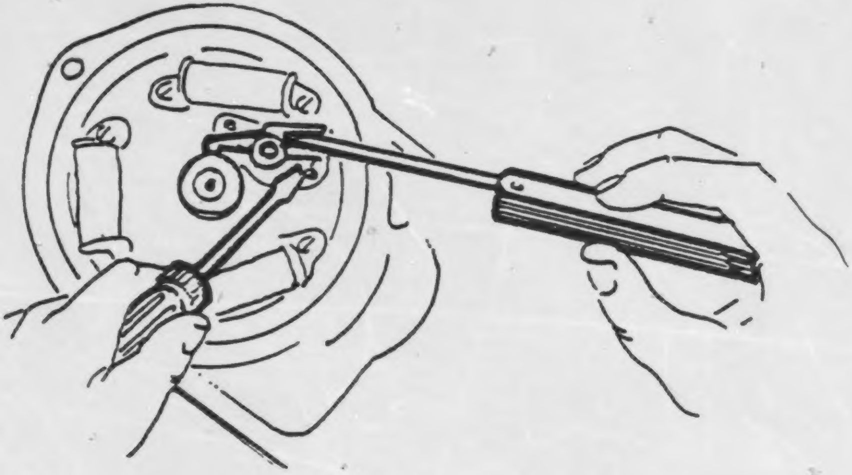
5. Check all wires to see if they are broken or corroded. Repair as needed.



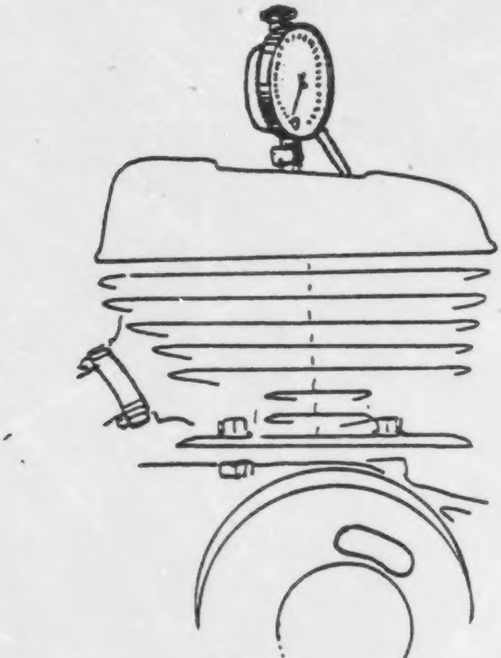
JOB STEPS

6. Once you clean the point area, slide the flywheel back on, but do not replace the holding nut.

7. Rotate the flywheel so that the points are at their widest opening. With a screwdriver, set them to manufacturer's recommended gap.



8. Remove the spark plug and install the dial indicator. Rotate the flywheel until the piston is at Top Dead Center. At T.D.C. set the dial face to zero.

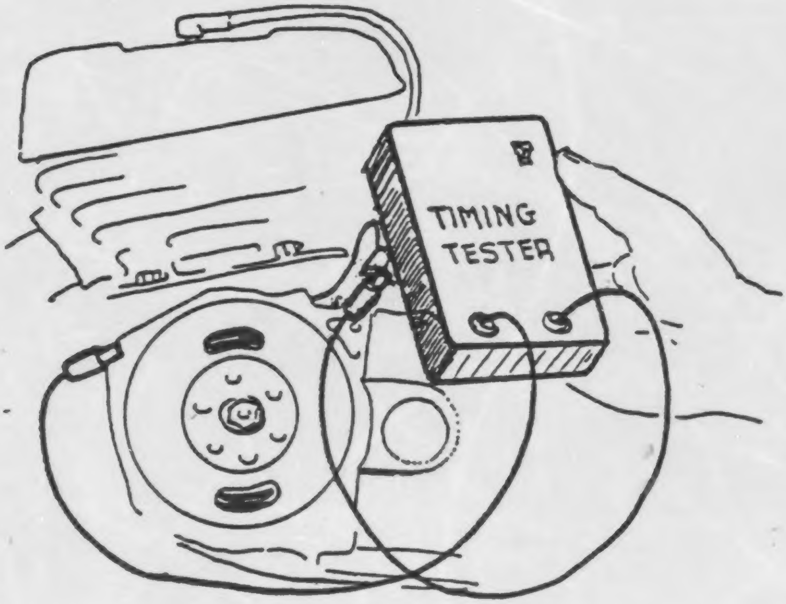


WORD GUIDE

"BUZZ BOX" - a device which produces a sound to aid in timing.

JOB STEPS

9. Ask your instructor for help with this step. Hook one lead from the "buzz box" to a ground. Hook the other lead to the coil wire from the magneto. (You may have to refer to a wire code for your bike.)



WORD GUIDE

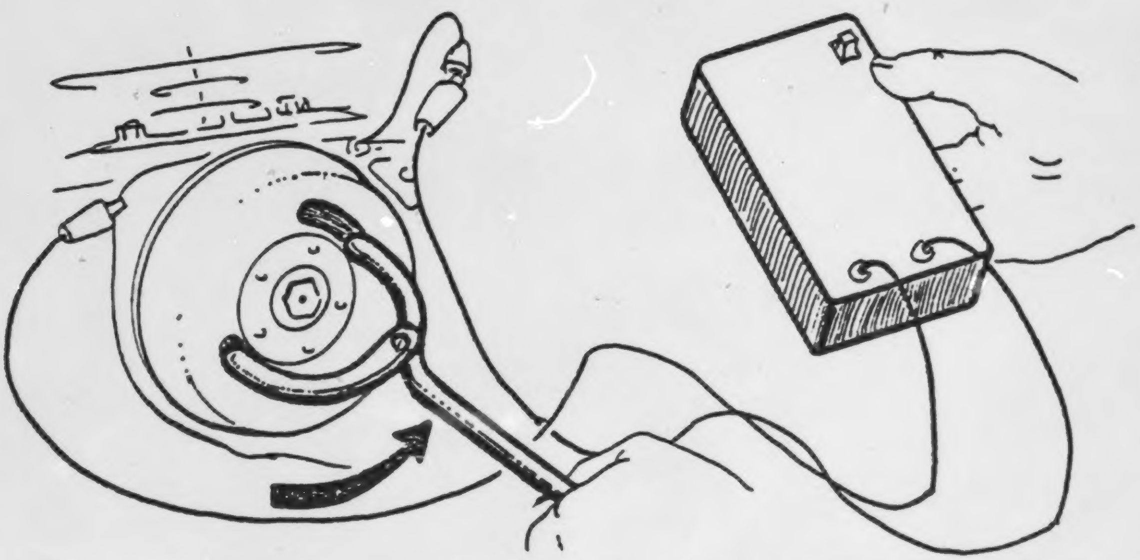
B.T.D.C. - Before Top Dead Center. The point where the cylinder is fired.

JOB STEPS

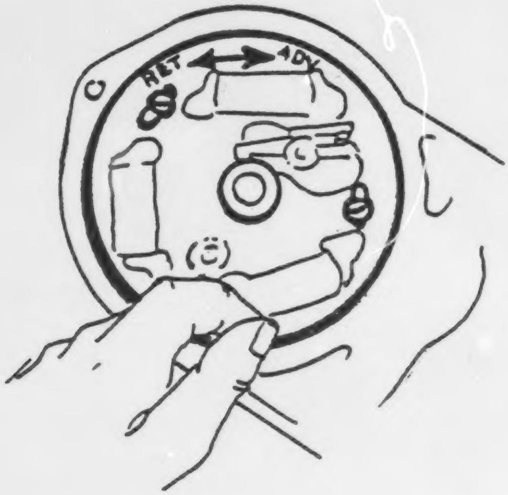
10. Check the manual that covers your bike for the timing specifications. You should find a specification either in millimeters or thousandths before T.D.C. (B.T.D.C.). Then, back off the flywheel that distance by using the dial indicator. Make a note of this reading on the indicator and remember it!!

JOB STEPS

11. Continue to rotate the flywheel down approximately .015. Now turn on the "buzz box." Start to rotate the flywheel back up to T.D.C., listening to the tone coming from the "buzz box." When you reach that point (the reading underlined above), the tone should noticably change. If it does, timing is set correctly. If not ....



12. If the buzz tone changes before or after B.T.D.C., loosen the three Phillips screws that hold the backing plate and move the plate in the desired direction to retard or advance the timing spot.



JOB STEPS

13, Once the timing has been set to the recommended specifications, the dial indicator must be removed.

14. Clean and gap the spark plug, or replace it if needed.

15. Torque the holding nut for the flywheel.

16. Hook wire back to coil and check for spark. You should be ready to start the cycle.

small engine repair

unit: Motorcycle

capital area career center

module: 7501 14 002 **date:** 4/73 **level:**

skill title: Timing a Single Cylinder
Points Accessible

developed & written by: Don Foster

visuals by: Dave Wehrwein

WORD GUIDE

± - Plus or minus.

PERFORMANCE OBJECTIVE

You Are Going To Learn:

How to set the points and time the engine.

And In Order To Do This You Will Need:

A spark plug wrench	Metric wrenches
Phillips screwdriver	Buzz box
Oil pan	Timing light
Impact driver	Manufacturer's manual

We Will Know You Can Do It When:

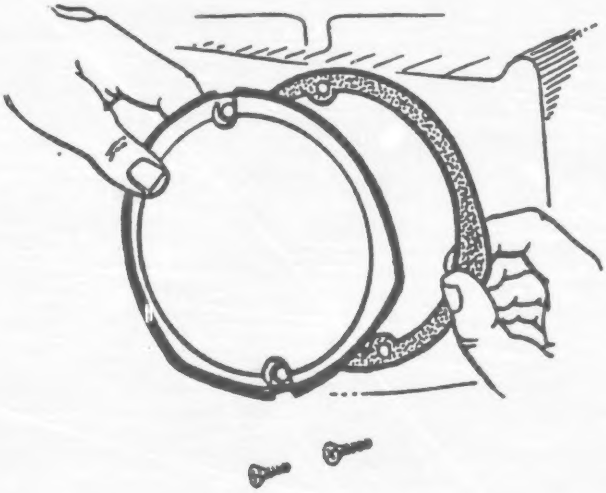
You set the points not more than ± .002 off the manufacturer's specifications, using the buzz box. The "hash" marks on the rotor line up at an idle, using a timing light. The hash marks on the rotor also line up at 4,000 R.P.M.'s.

JOB STEPS

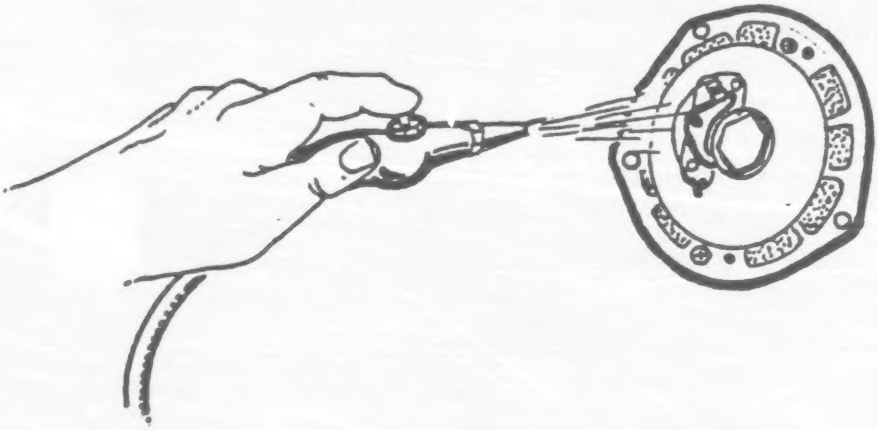
1. Check to make certain that you have a full charge in the battery, as this is a must in battery ignition system.

2. Remove the spark plug.

3. Remove the phillips screws. Pull the cover (left side) and gasket off and set aside.



4. Clean the point area with compressed air. Pull a piece of paper through the points to clean off oil, dirt, or grit. Do not file the points.



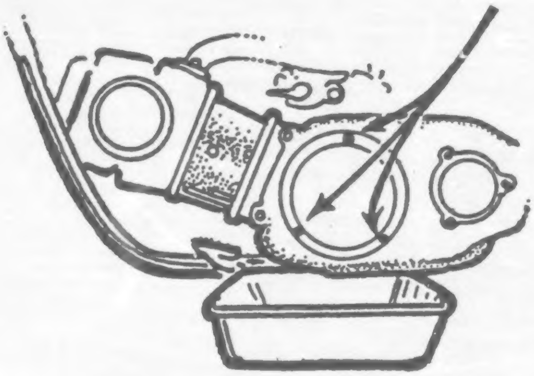
WORD GUIDE

PITTED - Hollowed out or a surface having holes.

JOB STEPS

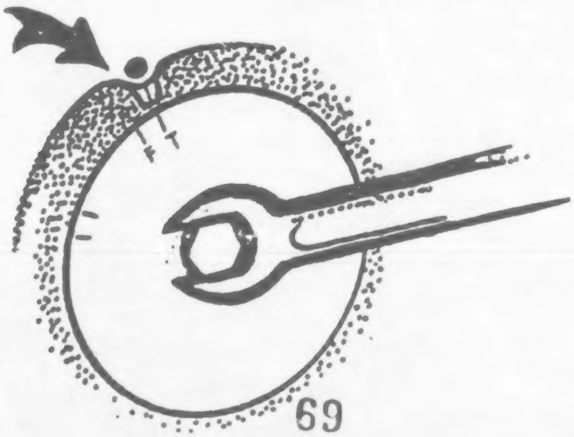
5. If points are pitted or burned, replace them. If in good condition, reset them to specifications given in the manual.

6. Still working on the left side, remove the alternator cover. When this cover is removed, a small amount of oil will drain out. Be sure to use a pan or some container to catch the oil. The exposed parts are the stator and rotor.



7. Rotate the rotor with a wrench so that the "T" lines up with indicator shown in the picture below:

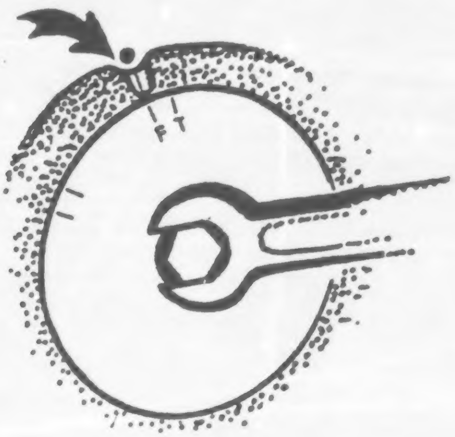
   This must be done on the compression stroke.



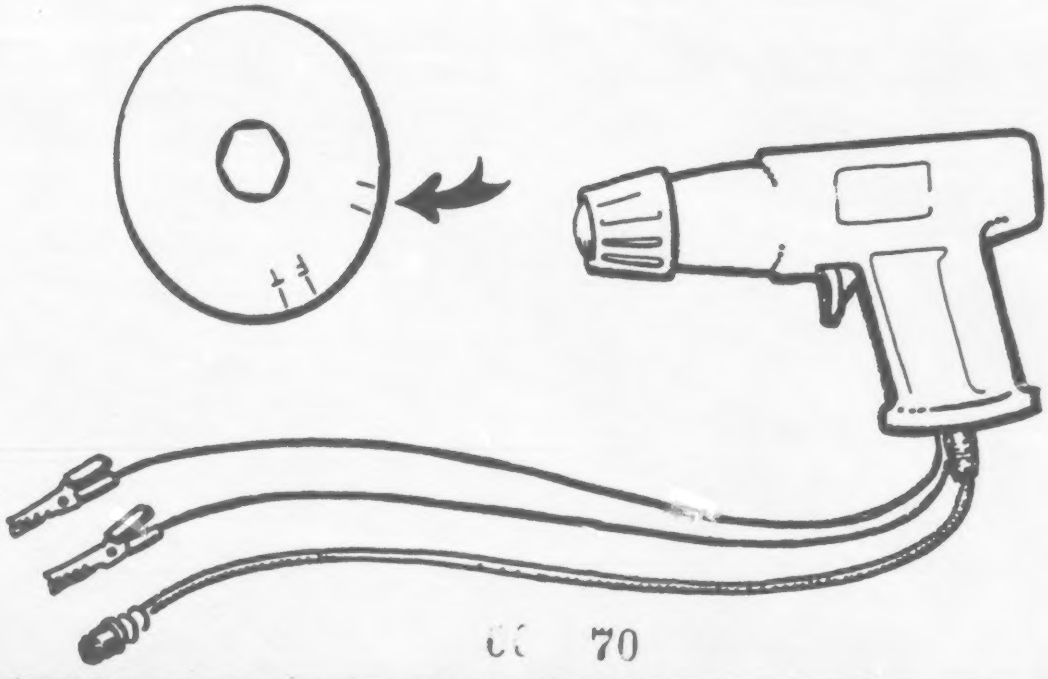
JOB STEPS

8. Connect the leads of the buzz box to the ignition wires at the disconnect.

9. Roll the engine over with a wrench. As the points open the buzz tone should change when the (fire) line "F" is in line with the indicator. (If it doesn't, read step #14)

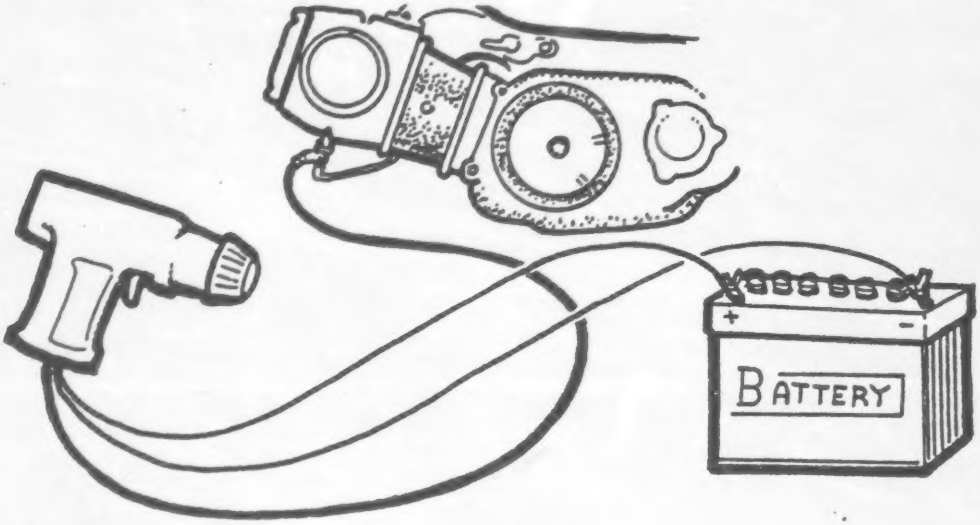


10. There are two other marks on the rotor which are used to check the advance timing. To do this we need a stroke-type timing light.



JOB STEPS

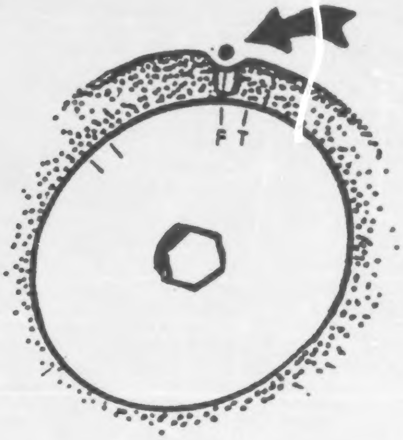
11. Replace the spark plug and attach the timing light lead to the spark plug wire. Also, connect the other leads of the timing light to a battery. (You can use the battery on your bike if it is charged!)



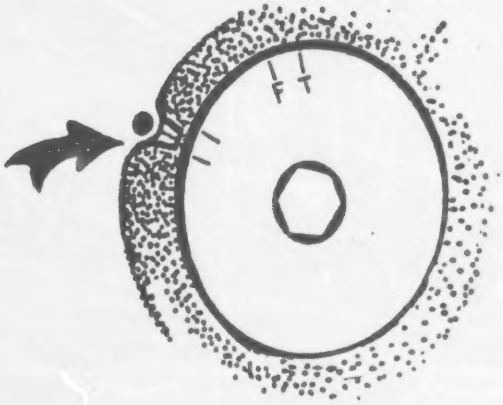
12. Now, with timing light attached and cover plate off, start the bike.

JOB STEPS

13. Press the trigger of the timing light and note the positions of the timing marks on the rotor. At an idle, the "F" should line up with the stationary pointer.



Also, at 4,000 R.P.M. the two side by side (non-marked) lines on the rotor should line up with the stationary pointer.



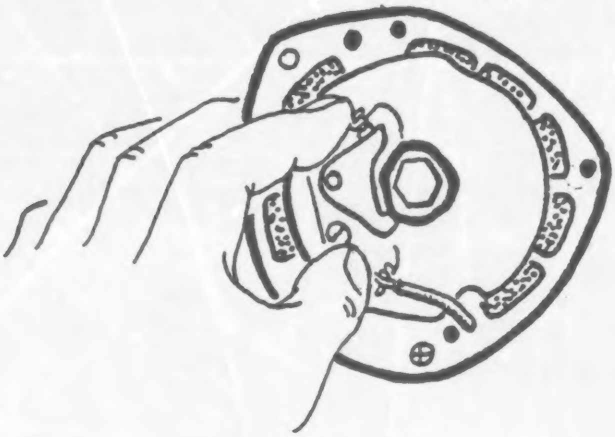
If these conditions are met, then the bike is timed. If not . . . .

WORD GUIDE

CLOCKWISE	In the same direction as hands moving on a clock, or to the right.
COUNTER-CLOCKWISE	In the opposite direction as hands moving on a clock, or to the left.

JOB STEPS

14. Loosen the retaining screws on the point backing plate and rotate the plate either clockwise or counter-clockwise to bring the timing in so that the timing marks line up.



15. Replace covers with gaskets and replace tools and equipment.

small engine repair

unit: MOTORCYCLE

capital area career center

module: 7501 14 003 date: 4/73 level:

skill title: Timing a Two Cylinder with Single Points (Points Accessible)

developed & written by: Don Foster

visuals by: Dave Wehrwein 74

WORD GUIDE

SPECIFICATIONS - Detailed plans or required limits of something.

PERFORMANCE OBJECTIVE

You Are Going To Learn:

How to adjust the points and time that particular engine according to manufacturer's specifications.

And In Order To Do This You Will Need:

Metric wrench

Hammer

Timing light

Feeler gauge

Small screwdriver

Impact driver

Dial indicator

Buzz box

Phillips screwdriver

Manufacturer's manual

2-cylinder, single point motorcycle engine

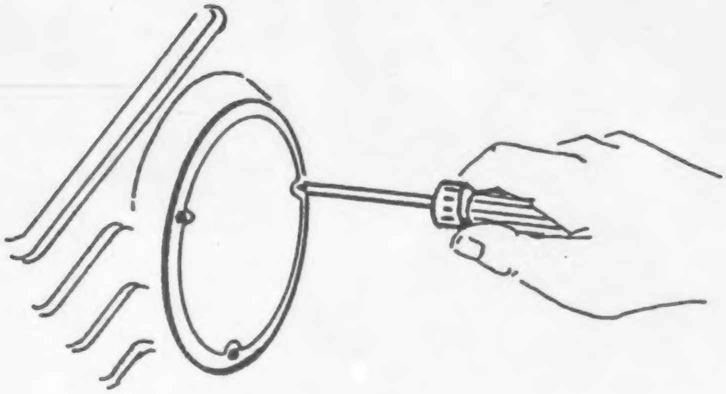
We Will Know You Can Do It When:

1. You have set the points to within ± .002 of manufacturer's specifications by using the buzz box and dial indicator.
2. Using the timing light, you have lined up the "hash" marks on the rotor line, with the engine running on idle.
3. Also using a timing light, you have lined up the "hash" marks with the engine running at 4,000 R.P.M.

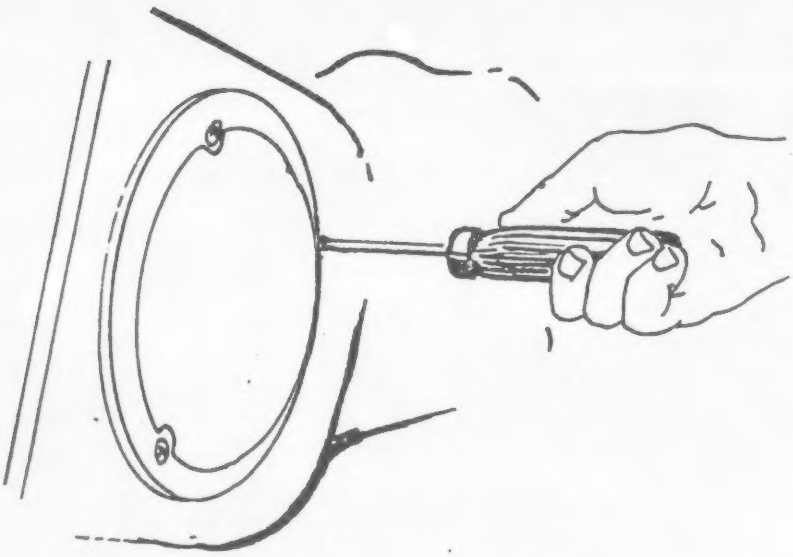
JOB STEPS

1. Remove the spark plugs.

2. Remove the contact cover plate.



3. Then, remove the screws that secure the alternator cover. Remove the cover plate.

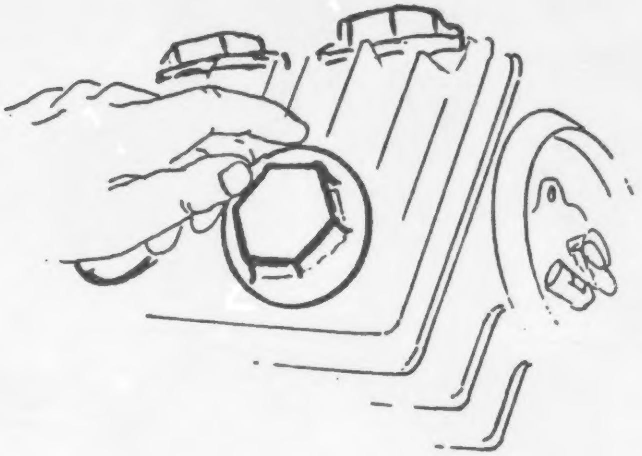


JOB STEPS

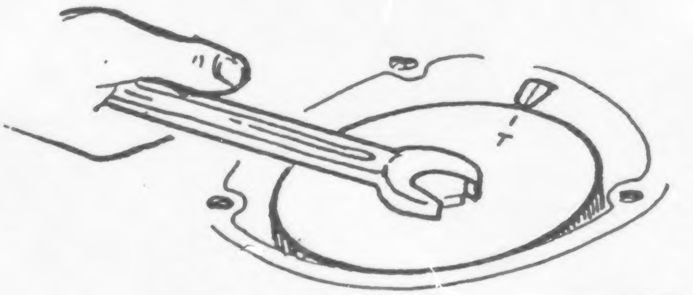
4. Clean the points by blowing compressed air over the area. Then, take a piece of stiff paper and place it between the points. Pull it in and out a few times. Do not file the points.

5. If they are not burnt or pitted, reset the points to factory specifications. If they are, replace with a new set and a new condensor.

6. Remove all four rocker arm covers.



7. Rotate the rotor with a wrench until the left intake valve opens. Keep rotating until the "T" aligns with the stationary mark as shown (some rotors have marks without a letter).



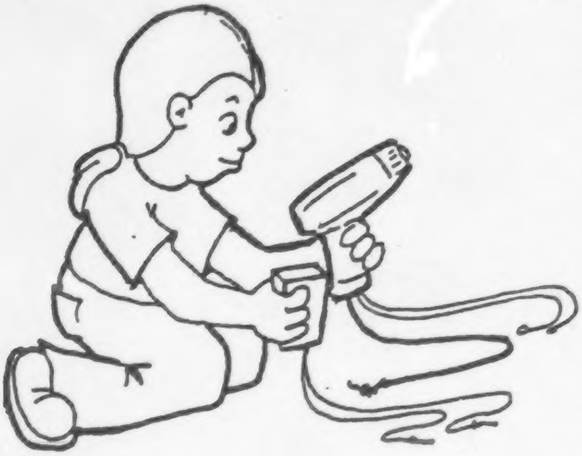
WORD GUIDE

T.D.C. - Top Dead Center. When piston is flush with top of block.

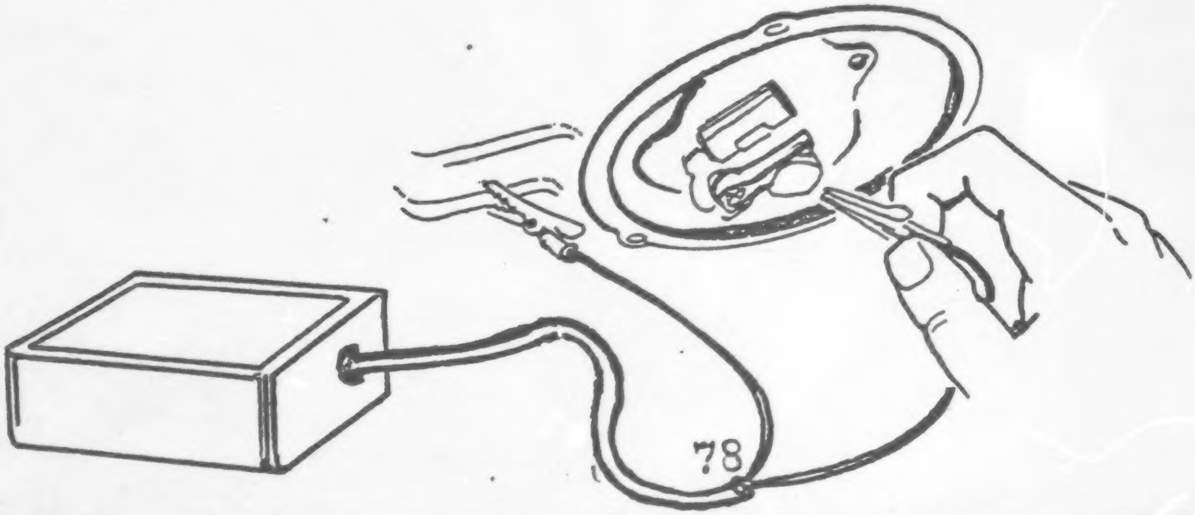
JOB STEPS

8. With the engine at T.D.C. on the compression stroke for the left cylinder, adjust both exhaust and intake valve on this side. Check the manual for proper valve clearance.

9. You can use either a buzz box or a timing light.



10. We will use the buzz box first and connect one lead to the ground and one to the contact terminal.



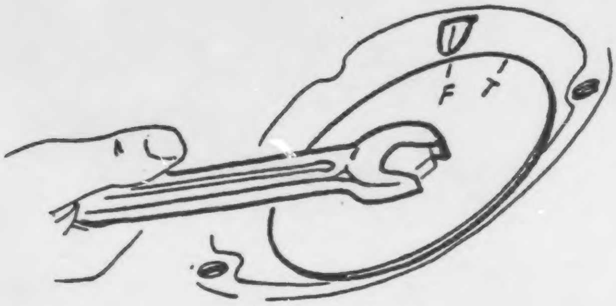
WORD GUIDE

CLOCKWISE - In the same direction as hands moving on a clock, or to the right.

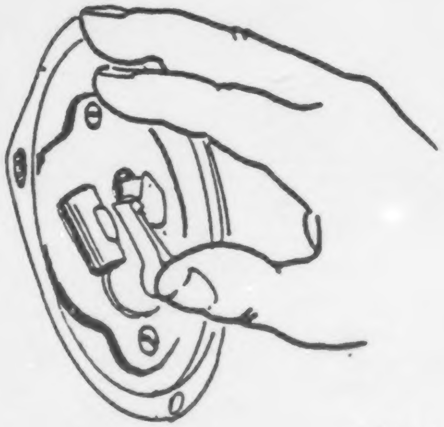
COUNTER-CLOCKWISE - In the opposite direction as hands moving on a clock, or to the left.

JOB STEPS

11. Rotate the engine forward. When the "F" (if your rotor has a letter marking) and the stationary indicator line up, there should be a change in buzzer sound from the buzz box. If there is, the timing is right. If not . . . .



12. Loosen the contact breaker-point plate screws and rotate either clockwise or counter-clockwise to time engine, marks and buzzer. Re-tighten screws and try again.



JOB STEPS

13. You may have to try step 12 a couple of times before your timing is correct. Once timed properly, both cylinders are timed!

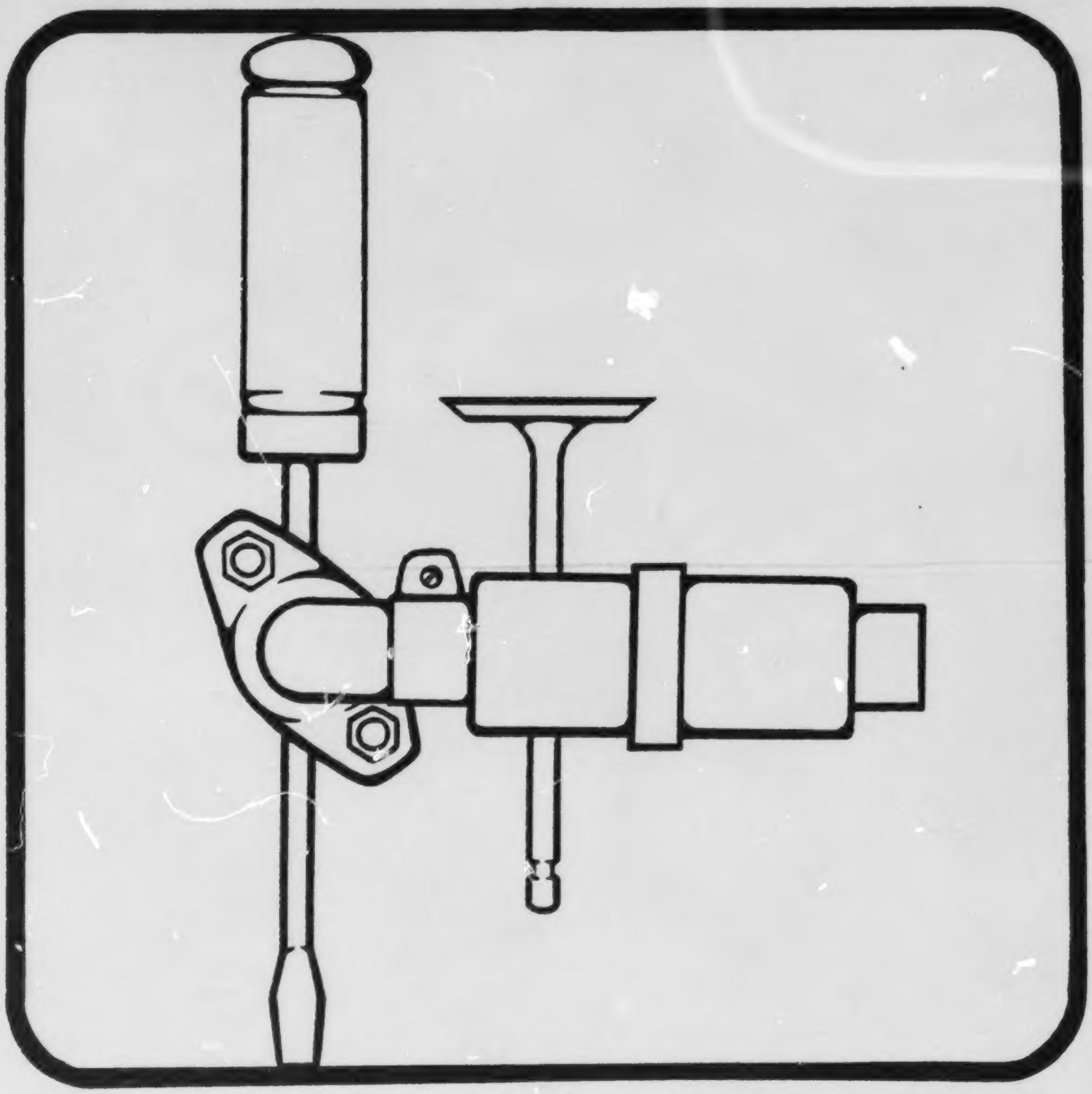
14. Now connect the snap ring from the timing light to the left spark plug lead wire.

15. Next, attach the leads from the timing light to a battery source.

16. Start the engine, point the timing light at the rotor and pull the trigger. If the "F" does not align with the stationary indicator, loosen the screws on the contact point plate and rotate either counter-clockwise or clockwise until the timing mark aligns correctly with the stationary indicator.

17. Run up the R.P.M.'s until the two (unmarked) marks align with the stationary indicator. Again, once this procedure is completed, both cylinders are timed.

    NOTE: When using this procedure, be prepared for oil spraying around.



small engine repair

unit: ENGINE REMOVAL AND REPLACEMENT

capital area career center

module: 7501 15 001 **date:** July 1977 **level:** IV

skill title: Remove and Replace Engine; Align to Drive Train

developed & written by: Jim Pitts

visuals by: Bruce Bennett

WORD GUIDE

ALIGN - To put parts of a unit in proper placement.

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to remove and replace an engine and then align and attach it to the drive train.

AND IN ORDER TO DO THIS YOU WILL NEED:

A 2- or 4-cycle engine mounted to a machine that runs

Drain pan

Air wrench

Engine hoist

Hand tools

Service manual

Torque wrench

Module 7501 15 007

WE WILL KNOW YOU CAN DO IT WHEN:

You have removed and replaced the engine and then aligned and attached it to the drive train.

INFORMATION

Many times you will have to take an engine off a unit and put it back on again. The engine then must be aligned so the belt or chain will not wear out or break. The PTO shaft must also be aligned properly so it will work.

Each engine is mounted differently. You must check to see how to put on the following parts:

Throttle linkage

Choke linkage

PTO

PTO shaft

Engine mount bolts

Electrical connections

Belt

If you have the right manual, follow the instructions inside for the kind of engine on which you are working. You will also have to look up the bolt torque specifications.

JOB STEPS

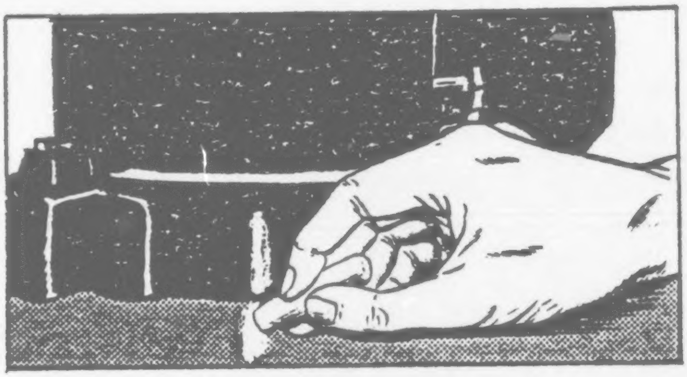
1. Take all equipment and materials to your work area.

2. Using wrench and drain pan, drain engine oil.

3. Using wrench and screwdriver, remove air cleaner or cleaners.

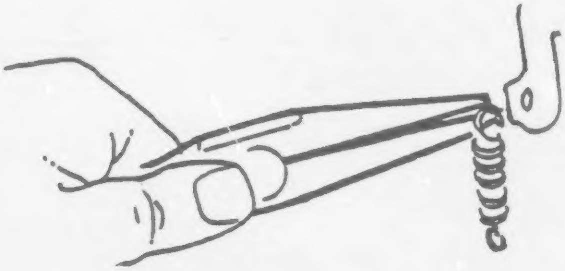
4. Drain or shut off gas supply.

5. Using chalk, mark place of engine mounting and alignment on the block and frame.



6. Unhook battery (if electric starting system).

7. Using plier, unhook throttle and choke control.



JOB STEPS

8. Using screwdriver, remove any belt guard or shroud for easier access to mount bolts. Check for different length bolts and where they go. Remove belts.

9. Using air wrench and sockets, remove mount bolts.

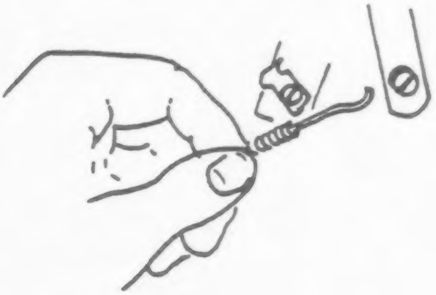
10. Remove engine from frame (if cast iron or heavy engine, use winch or chain fall) Clean off engine mounts and frame where engine goes.

11. Set engine in place and align to your marks.

12. Install engine, mount bolts and torque down.

13. Replace belt and check belt alignment. Then replace guards.

14. Hook up throttle control and adjust.



WORD GUIDE

CENTRIFUGAL CLUTCH - Clutch which engages from spinning at speeds faster than idle speed.

JOB STEPS

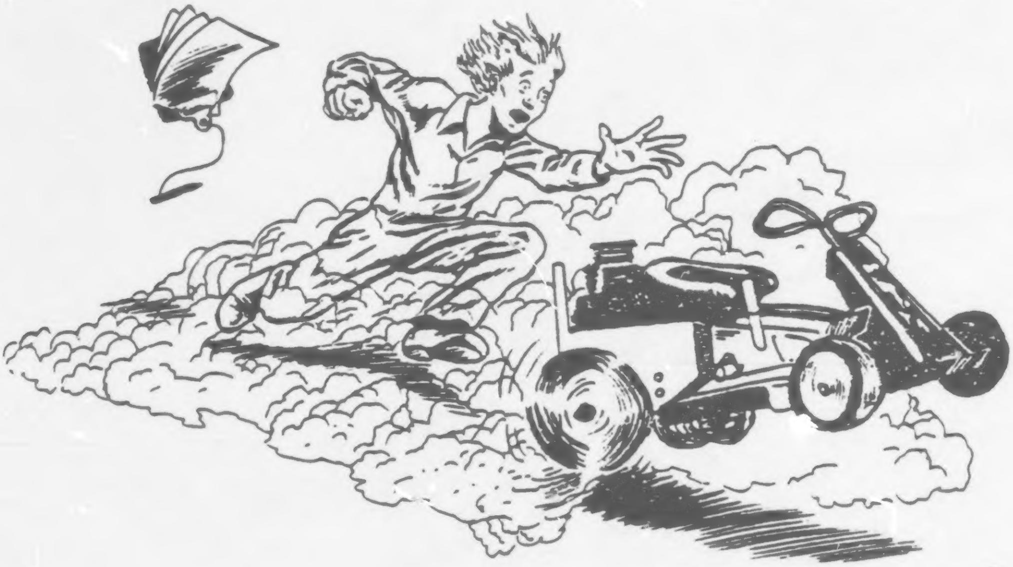
15. Hook up choke control and check to see that it works. Make sure you know full on and off points of carburetor. See module 7501 15 007.

16. Hook up battery or wiring.

17. Fill the machine with gas and proper oil (check service manual for proper lubrication oil).

THINK SAFETY!

18. If engine has centrifugal clutch (as on a snowmobile or mini-bike) be sure carburetor is running completely closed on idle as unit may start moving immediately and you may not be able to stop until it hits something. ALWAYS LIFT BACK OF SNOWMOBILE SO TRACK DOESN'T TOUCH GROUND! On a mini-bike raise rear wheel before starting engine.



JOB STEPS

19. Start and check running Adjust idle so track or rear wheel stops when engine is idling.

20. Lower track or rear wheel to ground and clean up unit for customer pick-up.

small engine repair

unit: Engine Removal and Replacement

capital area career center

module: 7501 15 002 **date:** 7/77 **level:** IV

skill title: Remove and Replace Engine on Push Mower

developed & written by: Jim Pitts

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to remove and replace the engine on a push type lawn mower.

AND IN ORDER TO DO THIS YOU WILL NEED:

Hand tools

Modules 7501 11 001 and 7501 15 007

Impact wrench

A four-cycle or two-cycle engine mounted on a push type lawn mower

Service manual

WE WILL KNOW YOU CAN DO IT WHEN:

You have removed and replaced the engine on a push type lawn mower so that the engine is mounted tightly to the mower and the blade does not hit the mower when the engine is running.

INFORMATION

Many times, you will have to change the engine on a push type mower. When the instructor gives you the mower to work on, get a service manual for that type. Look for the following things:

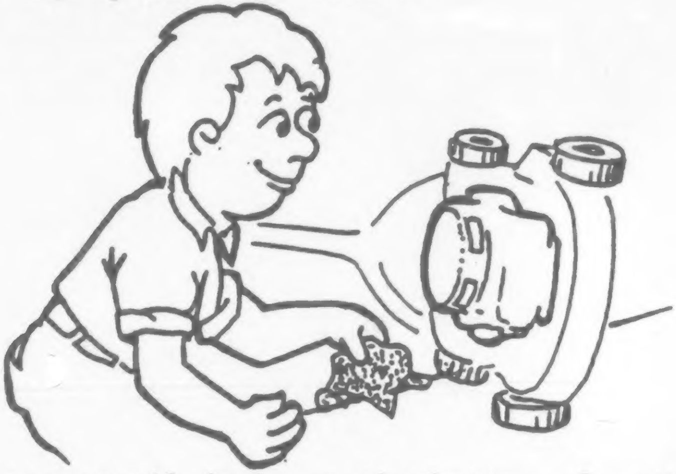
1. The oil drain plug
2. The way the throttle and choke hook-up
3. The engine mount bolts

JOB STEPS

1. Take all equipment and materials to your work area.

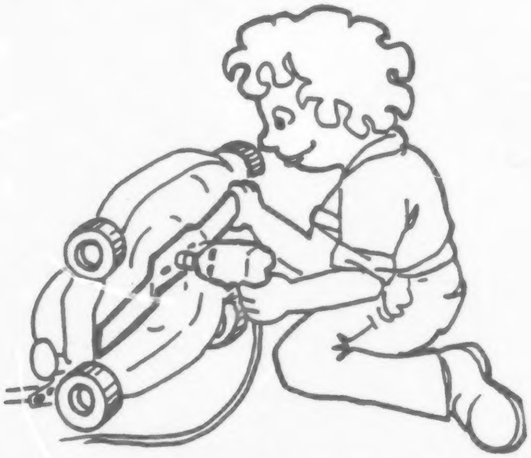
2. Lift mower onto the work bench. If mower is heavy, get help. Remember: Remove spark plug wire from plug before lifting.

3. Tip mower on side with valve breather assembly up so the oil will go into the head area. Watch for fuel and oil spills and wipe up any spills that occur.



4. If you can see an oil drain on the bottom of engine, remove it and drain the oil into the oil drain pan.

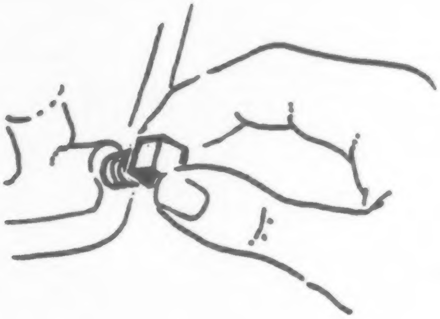
5. While oil is draining, use impact wrench and proper socket to hold blade and remove blade bolt (usually right hand thread bolts).



NOTE: Notice how blade and hub assembly go together. If you can't remember how the blade goes together, lay it out in the order you remove it. See module 7501 11 001.

JOB STEPS

6. Remove oil drain pan. Wipe up any oil spills. Put oil drain plug back in.



7. Remove engine mounting bolts (usually 3 or 4 bolts). Remove all mounting bolts and nuts except the last one.

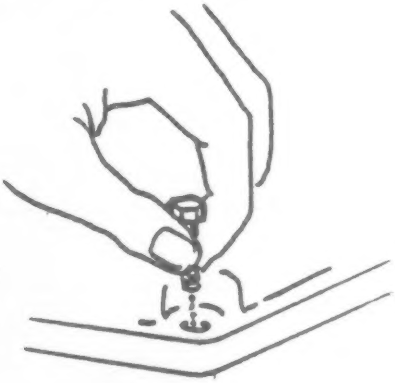
8. Tip mower back upright on bench and remove the last nut and bolt.

9. If there are any throttle control cables, or starter control cables, remove them now.

10. Lift engine off mower. Get help if you need it.

11. Using help if you need it, put engine back on mower.

12. Put at least one mounting bolt through engine and mower and put nuts back on bolts. Leave loose.



JOB STEPS

13. Tip mower on side and put rest of mounting bolts in engine and mower. Leave all bolts loose.

14. Is blade sharp? If not, see mod 7501 11 001.

PUT ON YOUR GLASSES!

15. Put blade and hub assembly back on in same order as removed.

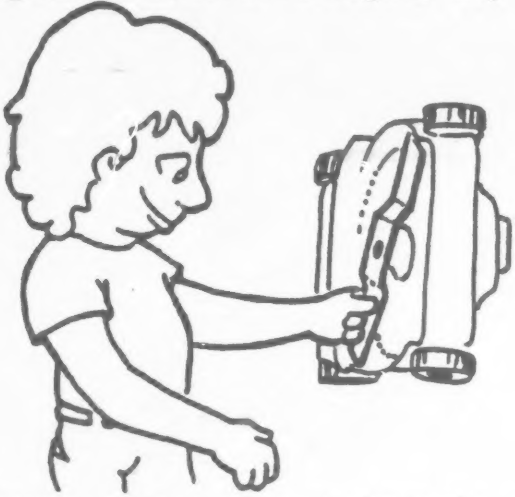
16. Using impact wrench and proper socket, tighten blade bolt. Let wrench hammer 5 or 6 times. Have blade and hub checked by instructor before starting engine.

17. Tighten oil drain plug.

    A. Rotate blade and see if blade touches the mower side or ends.

    B. If it touches anyplace, move engine away from where it touches and tighten bolts.

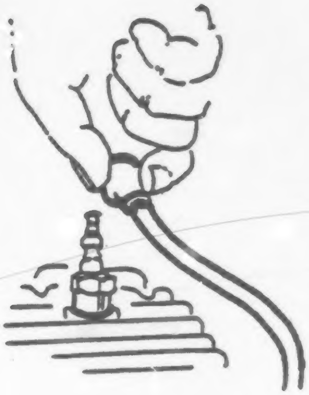
    C. Check blade again. If it is alright, tip mower back down.



18. Put oil back in mower. Hook up any throttle or starter control cables. Put mower back on floor (get help if mower is heavy).

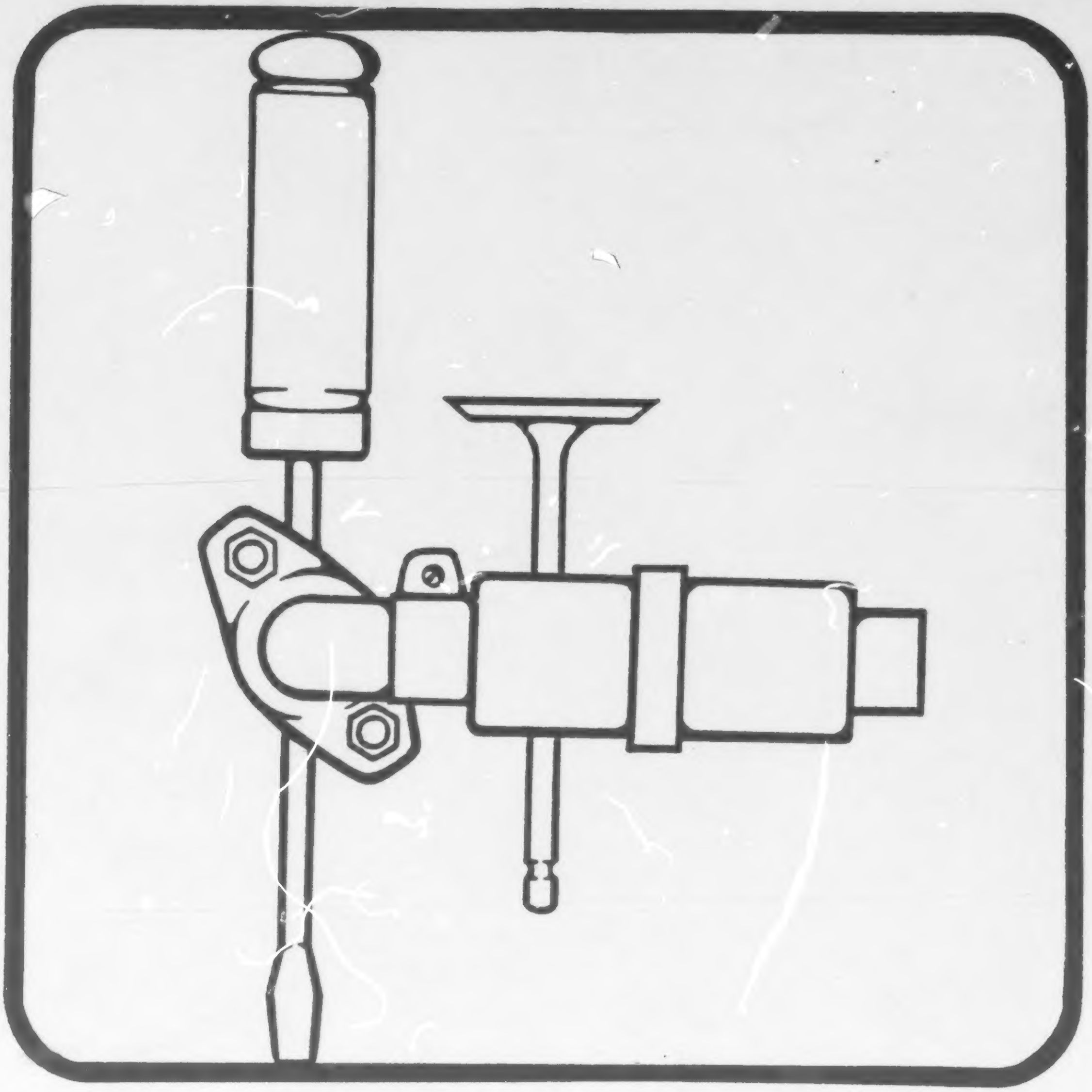
JOB STEPS

19. Hook up the spark plug wire. Be sure there is fuel in the tank.



20. Start the mower and adjust the throttle and choke. Be sure the mower runs properly. Shut off the mower. See module 7501 15 007.

21. Have the instructor check your work.



small engine repair

unit: ENGINE REMOVAL AND REPLACEMENT

capital area career center

module: 7501 15 003 **date:** July 1977 **level:** IV

skill title: Remove and Replace Engine on Self-Propelled Mower

developed & written by: Jim Pitts

visuals by: Bruce Bennett

INFORMATION

When you remove and replace the engine on a self-propelled mower, you must put the wheel drive unit back together properly. The important thing to do is look at the unit first to see how it is put on the mower. If you can use a service manual for this unit.

WORD GUIDE

AUXILIARY - Extra, reserve.

JOB STEPS

1. Take all equipment and materials and go to your work area.

2. Remove spark plug wire. Then, lift the mower onto the work bench. If mower is heavy, ask somebody to help you lift it.

3. Drain the gas.

4. Tip the mower on its left side.

5. Use the impact wrench and proper socket to remove blade.

6. Hold blade with one hand to keep it from spinning and use the other hand to run the impact wrench.

DO YOU HAVE YOUR SAFETY GLASSES ON?

7. When you take off blade and hub assembly, notice how they go together.

8. Loosen mounting bolts and nuts on the engine.

9. Remove all bolts and nuts, except one.

WEAR YOUR SAFETY GLASSES!

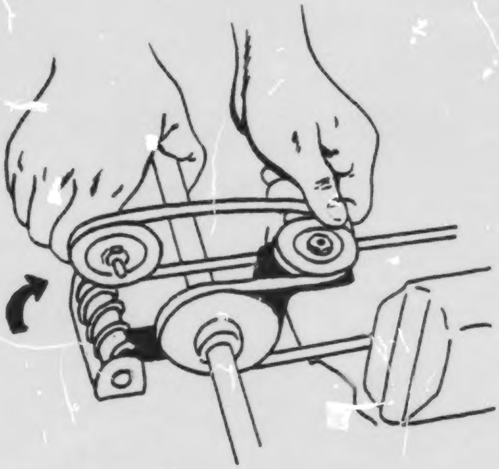
10. Tip mower back down on its wheels.

11. If there are any controls hooked to engine (such as throttle controls or starter controls) remove them now.

JOB STEPS

12. Remove remaining bolt and nut.

13. Remove the drive belt (or slide engine sideways away from the drive sleeve) and lift engine from mower. Get help lifting, if needed.



14. Put engine back on mower. Get help lifting engine, if needed.

15. Slide the engine toward the belt or toward the drive sleeve.

16 Put on at least one bolt and nut to hold engine in place.

17. Tip mower onto side again. Check to be sure belt is seated in pulley or drive pins are seated in drive sleeve.

18. Tighten engine mounting bolts.

19. Install balde and hub assembly. Is blade sharp? If it needs sharpening, refer to mod 7501 11 001.

20. Tighten blade with impact wrench.

21. Tip mower back down.

WORD GUIDE

ALIGNMENT - Proper positioning.

JOB STEPS

22. If belt is on top of mower, install the belt and check its alignment.

23. Check manual to see which way belt may go in order to drive mower Forward.

    NOTE: If belt is installed wrong, mower will back up!

24. Hook up any controls to throttle or starter.

25. Put mower on floor. If needed, get help lifting mower to floor.

26. Put spark plug wire on spark plug.

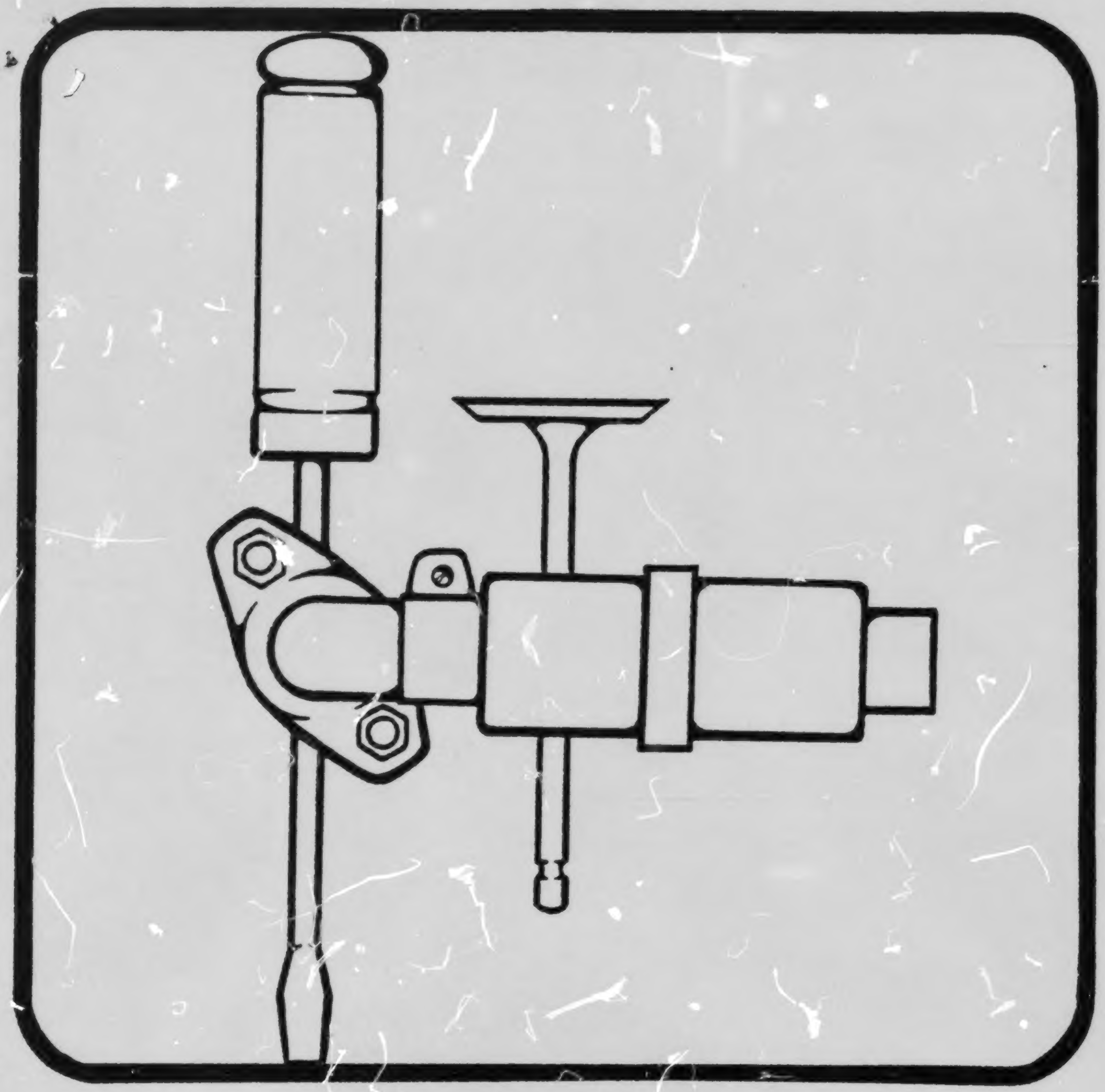
27. Put 2-cycle fuel in tank.

28. Make sure drive control is in neutral.

29. Start mower. DO NOT stand in front of it!

30. Adjust throttle and choke linkage. Follow module 7501 05 007.

31. Have the instructor check your work.



small engine repair

unit: ENGINE REMOVAL AND REPLACEMENT

capital area career center

module: 7501 15 004 date: May 1978 level: IV

skill title: Remove and Replace Engine on Electric Start Riding Tractor - Simplicity

developed & written by: Jack Helder

visuals by: Steve Bramer

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to remove and replace the engine on an electric start riding mower.

AND IN ORDER TO DO THIS YOU WILL NEED:

Simplicity Service Manual

Simplicity Electric Start Riding Mower

Simplicity Owner's Manual

Hand Tools

Oil Drain Pan

Torque Wrench

Modules 7501 06 001
7501 06 007
7501 11 011

WE WILL KNOW YOU CAN DO IT WHEN:

You have removed and replaced the engine so well that the riding tractor runs smoothly, with all parts in the right place.

JOB STEPS

1. Be sure you have finished the modules listed on the Performance Objective page and read the manuals for Simplicity Tractor.

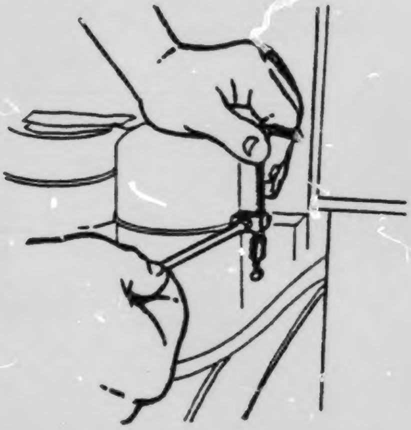
2. Remove the hood. Also remove the grill if possible.

3. Remove the negative (-) cable from the battery first. Then remove the positive (+) cable.

4. Remove the battery and place it on a shelf or board.

5. Remove all the shrouds or guards that cover belts.

6. Remove the throttle controls and choke controls.



7. Drain oil and wipe up any spills.

8. Remove any electrical wires leading to the engine or start generator.

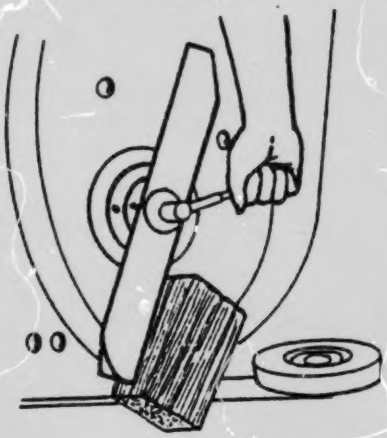
9. Remove engine mounting bolts. There will be 3 or 4 bolts.

NOTE: Mark the places where the motor sits on the frame.

JOB STEPS

10. Use a hoist to lift the engine only enough to remove belts from the engine pulleys. Go slowly.

11. Remove the blade and pulleys.



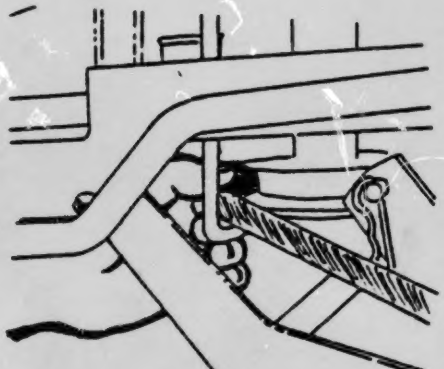
12. Have someone help you lift out the engine.

13. Do any needed repairs to the engine. Then ask if you can replace the engine.

14. Put the engine back on, but do not bolt it down.

15. Install blade and pulleys.

16. Put belts on pulleys. Be sure belt stop is installed right.



JOB STEPS

17. Install the mounting bolts, making sure engine lines up with marks you made in step 9.

18. Torque the mounting bolts. Ask your instructor how much pressure to use, or find specifications in repair manual.

19. Hook up throttle controls and choke controls.

20. Hook up all electrical wires.

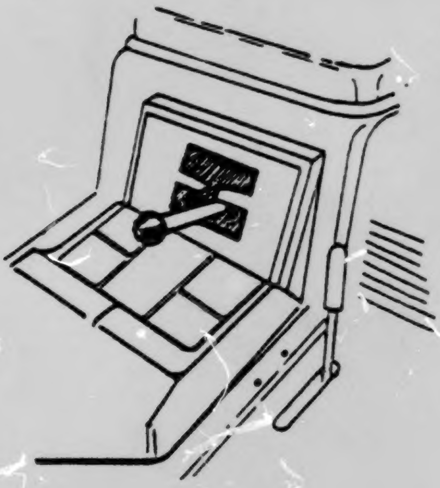
21. Fill engine with oil. Wipe up any spills.

22. Replace battery.

23. Hook up positive (+) cable.

24. Hook up negative (-) cable.

25. Put controls in neutral.

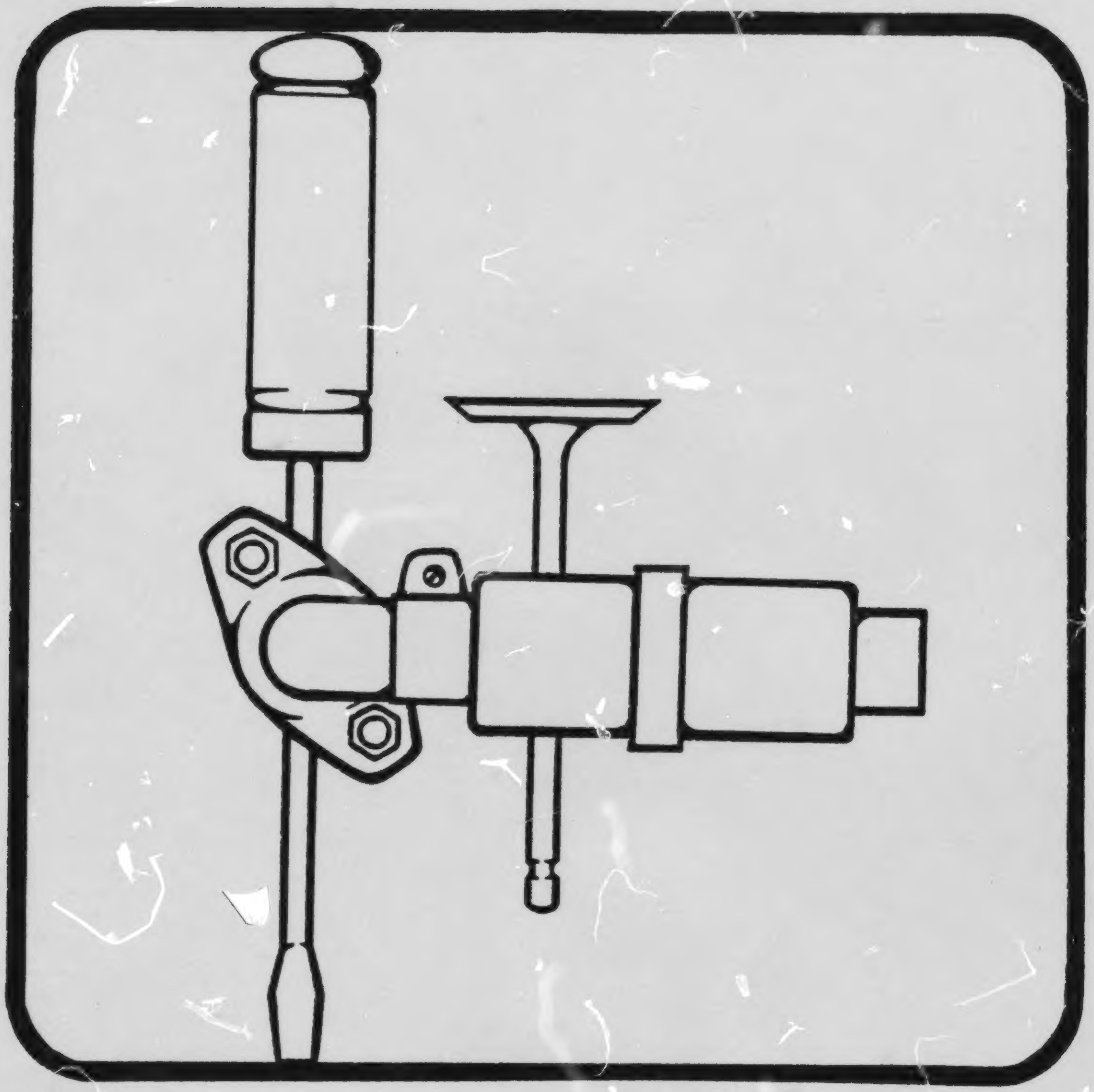


26. Start mower.

JOB STEPS

27. Test and adjust mower as needed.

28. Clean up the equipment and your mower.



small engine repair

unit: ENGINE BLOCK

capital area career center

module: 7501 15 005 date: July 1977 level: II

skill title: Remove and Replace Engine on Riding Mower - Jacobsen

developed & written by: Don Foster

visuals by: Bruce Bennett

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PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to remove and replace the engine on a Jacobsen riding mower.

AND IN ORDER TO DO THIS YOU WILL NEED:

Jacobsen riding mower
Hand tools
Oil drain pan
Jacobsen Operating Service Manual for model #42635
Impact wrench
Safety glasses

WE WILL KNOW YOU CAN DO IT WHEN:

You have removed and replaced the engine on a Jacobsen riding mower so it runs according to service specifications.

INFORMATION

Whenever you do major work on any piece of equipment you should refer to the right service manuals. Before changing the engine on a Jacobsen riding mower, read the Jacobsen Operating/Service Manual. Before starting work on the machine, look to see how the following parts are attached:

Throttle and choke linkage

Belts and pulleys

PTO

Blade

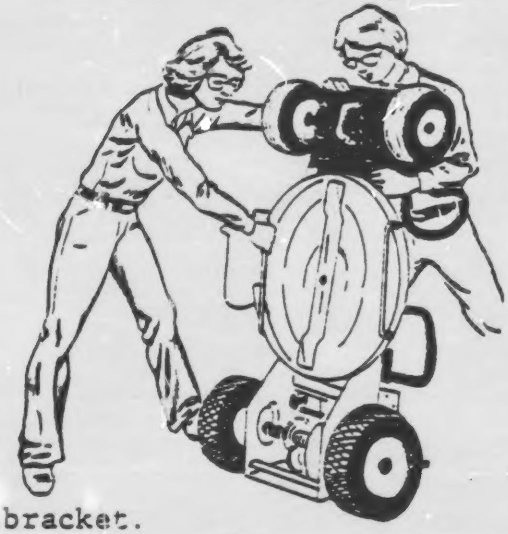
Seat and hood

If you are not working on Jacobsen equipment, follow the instructions in the service manual for the kind of equipment you have.

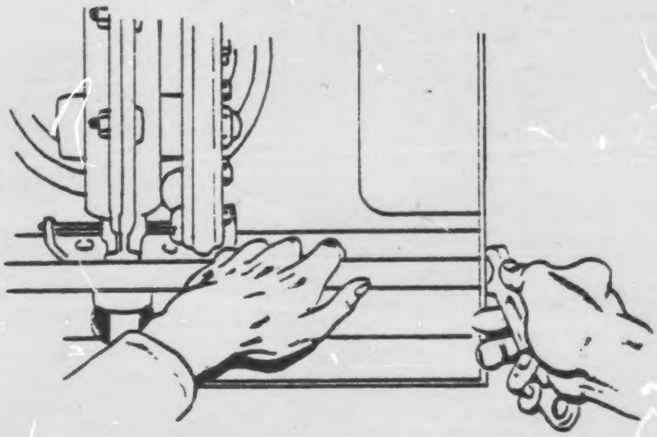
JOB STEPS

1. Take your equipment to the work area.

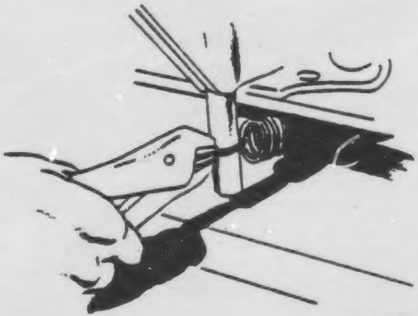
2. Tip the mower on its rear end and drain gas from tank.



3. Remove frame spacer bracket.

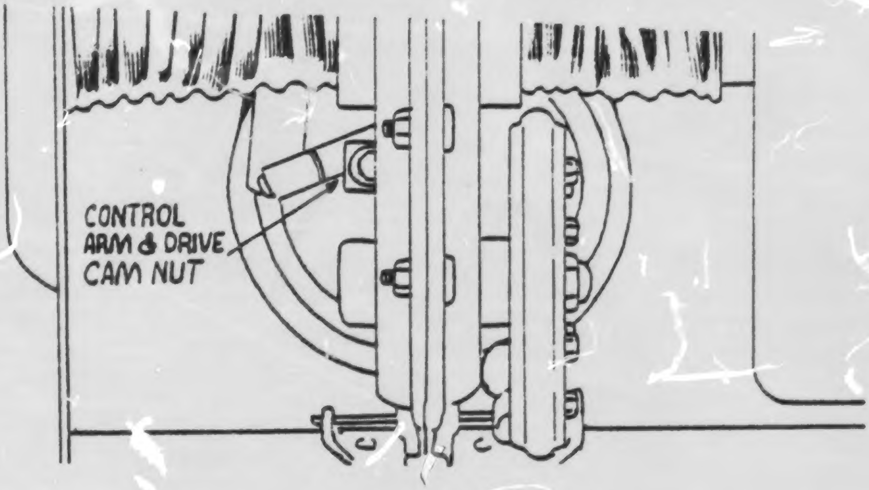


4. Use pliers to remove the drive tension spring.

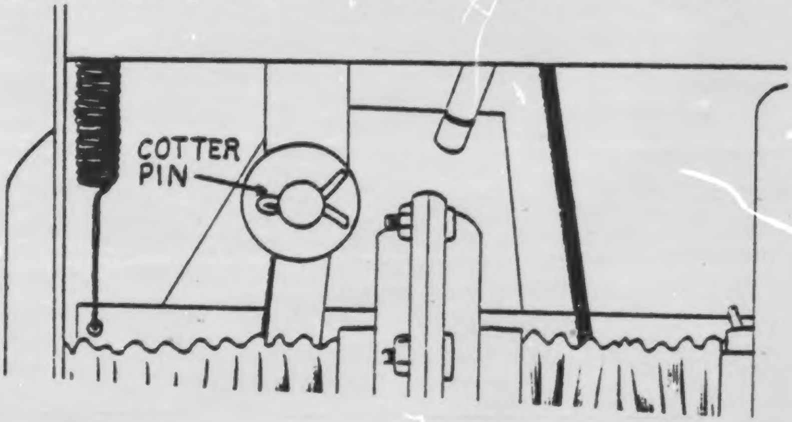


JOB STEPS

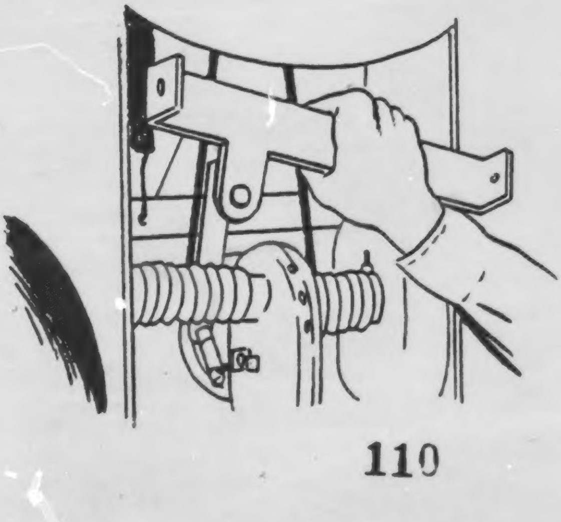
5. Now remove the nut to the control arm and drive cam.


CONTROL
ARM & DRIVE
CAM NUT

6. Take out the cotter pin from the clutch cross brace assembly.

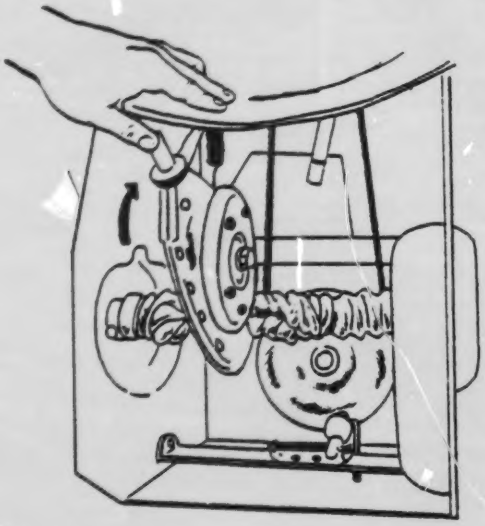


7. Take nuts and bolts out of the clutch cross brace assembly. Then remove the assembly.

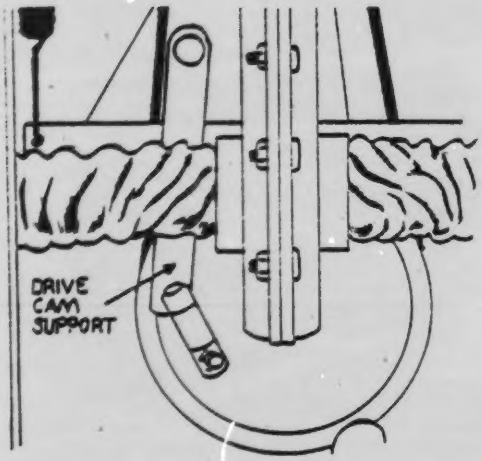


JOB STEPS

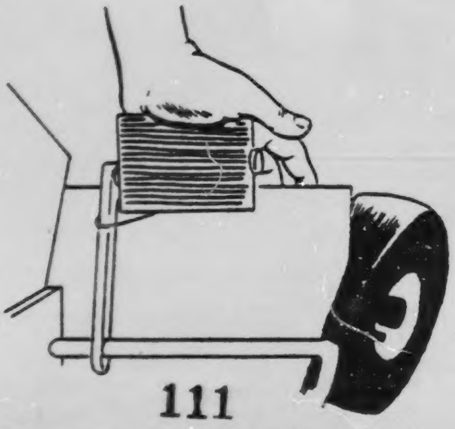
8. Wire the chain case up out of your way.



9. Remove drive cam support.

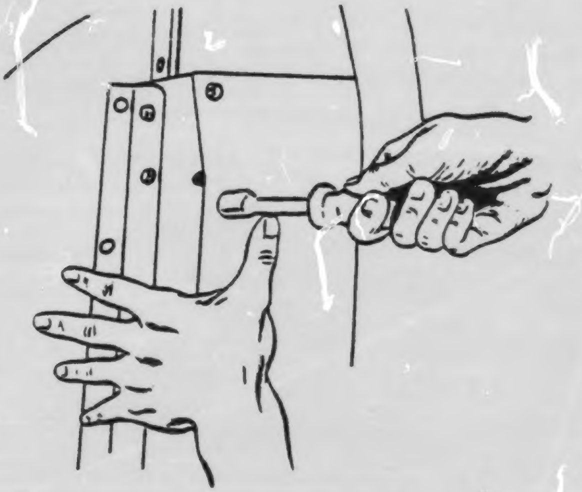

DRIVE
CAM
SUPPORT

10. Wire down the clutch pedal so it will not get in the way of the engine drive disk.

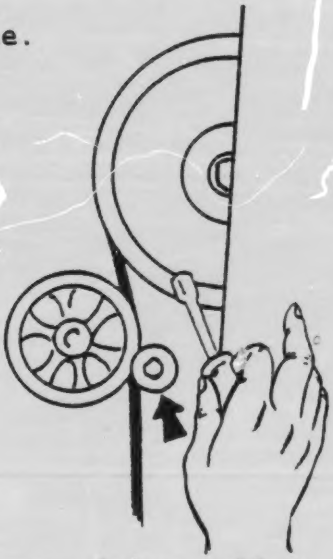


JOB STEPS

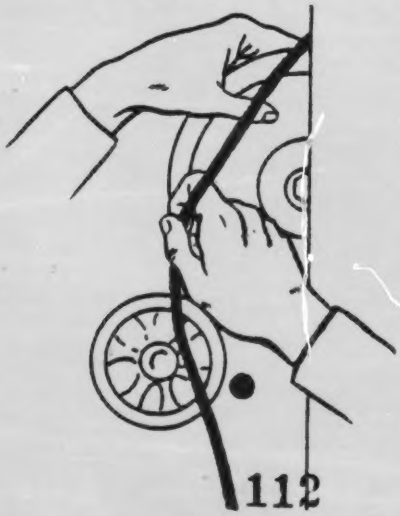
11. Use a 3/8 inch wrench to remove screws from the cover on the mower.



12. Remove the belt idler arm guide.

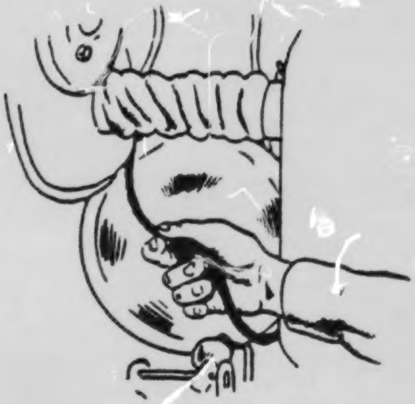


13. Now remove the belt from the mower drive pulley.

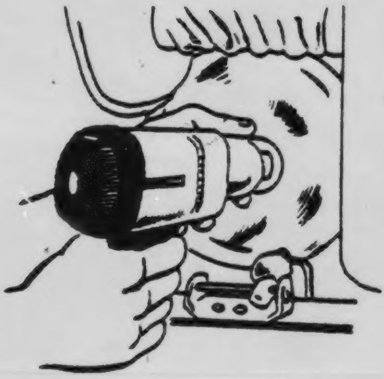


JOB STEPS

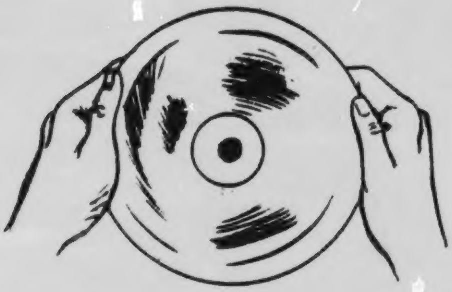
14. Now take belts off the other pulley and engine drive disk.



15. Get electric impact wrench and a 9/16 socket and remove bolt from engine drive disk.

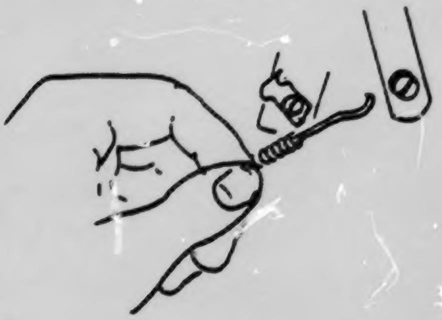


16. Use a hammer to tap the back of the engine drive disk until it comes off.

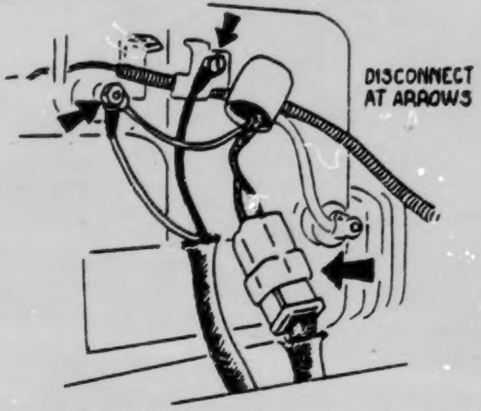


JOB STEPS

17. Remove the throttle cable from the engine.



18. Remove electrical wires to the engine.



19. Put the mower back down on its wheels and use a 1/2 inch socket and 9/16 inch wrench to remove engine mounting bolts.

20. Remove the engine.

21. Do any needed repairs to the engine Then reverse steps to put engine back on (see step 22).

22. First put engine back on and tighten mounting bolts.

JOB STEPS

23. Wire down clutch pedal and tip mower on its rear end.

24. Put on engine drive disk. Tighten on the bolt with a 9/16 inch socket and electric impact wrench.

25. Now remove wire from clutch.

26. Replace electrical wires and throttle cable.

27. Put belts back on all pulleys.

28. Replace belt idler arm guide.

29. Replace the mower cover.

30. Put back on the drive cam support.

31. Put on the clutch cross brace assembly.

32. Put cotter pin back in the cross brace assembly.

33. Hook up the control arm and drive cam. Tighten the nut.

34. Put on the drive tension spring.

JOB STEPS

35. Replace frame spacer bracket.

36. Put mower back on all 4 wheels and put gas in the tank.

37. Start mower and be sure that it goes forward and in reverse.

38. Check to see that mower blades are working.

39. Check all safety switches, then show your work to your instructor.

small engine repair

unit: Machining

capital area career center

module: 7501 16 001 **date:** 4/18/77 **level:** I

skill title: How To Install A Heli-coil Kit

developed & written by: Daniel M. Woodward

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

You are going to learn:

How to install a Heli-coil on the engine block.

And in order to do this you will need:

- Engine block with a stripped, threaded hole
- Heli-coil kit
- Tap handle
- Drill set
- Electric drill

We will know you can do it when:

You have safely completed the job steps and installed a Heli-coil into a hole with damaged threads so that it can be used.

INFORMATION

When do we use a "Heli-Coil"?

We use a Heli-Coil when we cannot use a standard tap and drill. We could use one when we strip a spark plug hole or some special part where the thread must stay the same.

What is a "Heli-Coil"?

It is a manufacturer's trade name for something which replaces a worn or damaged thread.

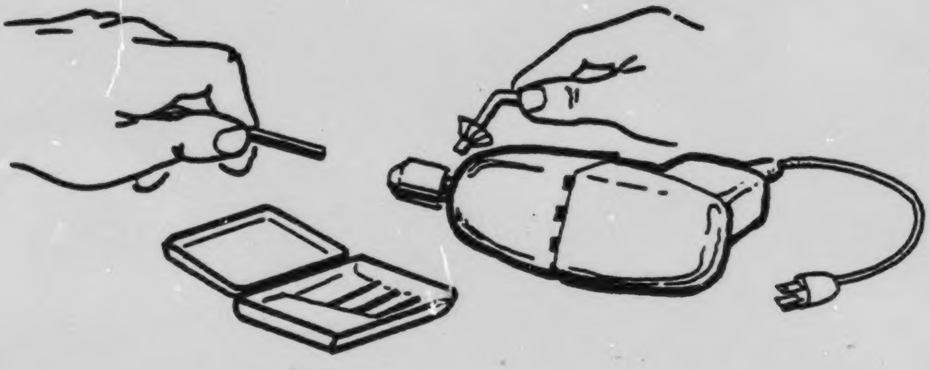
WORD GUIDE

CHUCK - Attachment on tool which holds workpiece.

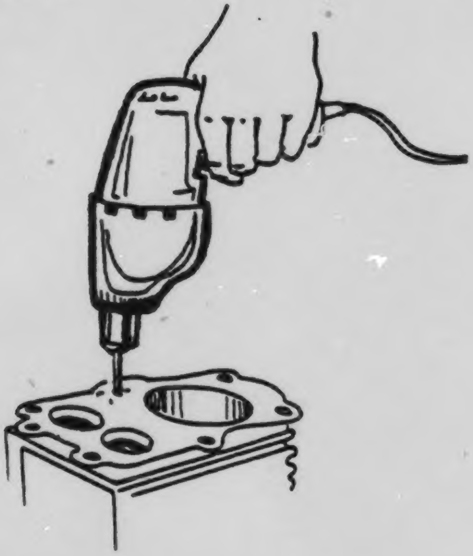
JOB STEPS

1. Find out the size of the damaged threads on the bolt.

2. Take a drill of that same size (1/4 drill if 1/4 bolt; 5/16 drill if 5/16 bolt), put bit into the chuck, and then plug drill into electrical outlet.

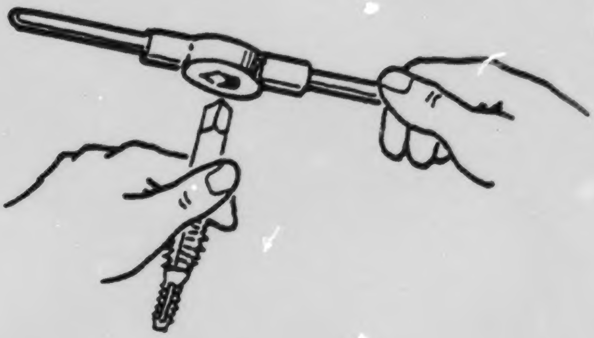


3. Drill old or damaged threads.



JOB STEPS

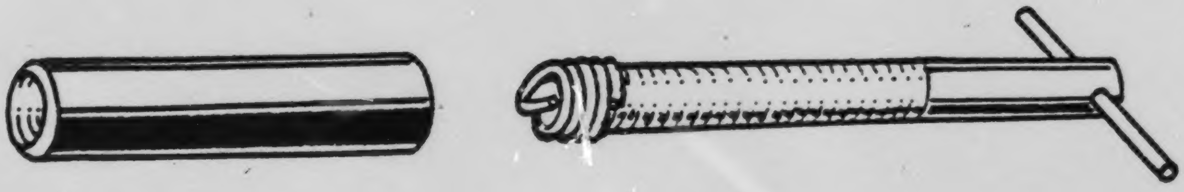
4. Get a Heli-coil tap the same size as the bolt you want to replace and tighten tap into tap-wrench handle.



5. Tap hole at least as deep as the length of the Heli-coil.

6. Select the proper Heli-coil and Heli-coil inserter, and thread the heli-coil onto the inserter.

   NOTE: Be sure the tang of the coil is seated on the drive hook.

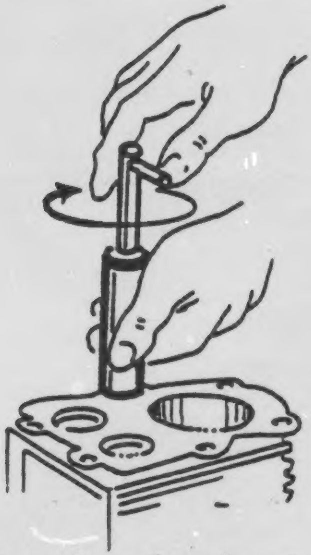


WORD GUIDE

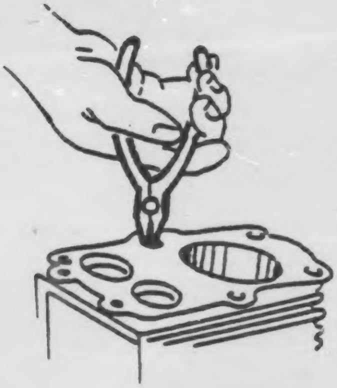
FLUSH - Flat, level.

JOB STEPS

7. Turn heli-coil into taped hole until it is flush.

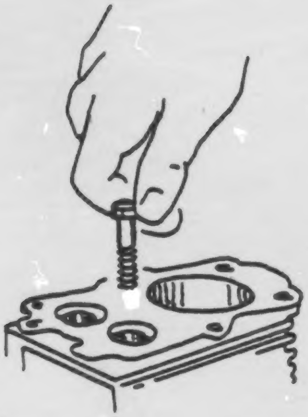


8. Use the break-off tool and twist to break off the tang from the coil.



JOB STEPS

9. Turn the new bolt into the threads and check for correct fit.



small engine repair

unit: Engine Block Machining

capital area career center

module: 7501 16 002 date: 5/77 level:

skill title: Drilling, Removing and Tapping Broken Studs

developed & written by: Jim Pitts and Don Foster

visuals by: Dave Wehrwein

WORD GUIDE

STUD - A bolt which does not have a head on it.

PERFORMANCE OBJECTIVE

You are going to learn:

How to remove a broken stud and then re-tap the hole.

And in order to do this you will need:

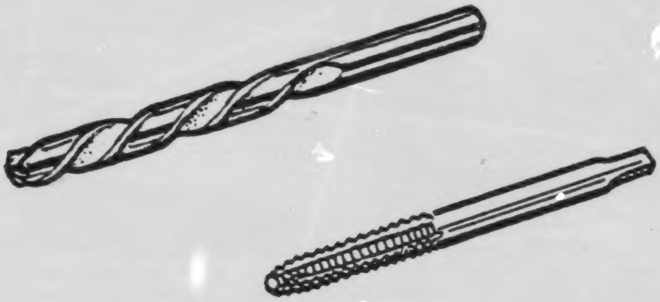
- A part with the stud broken off at or below the surface
- drill motor
- drill index
- easy out set
- tap and die set
- hand tools
- thread guage
- tap drill size chart

We will know you can do it when:

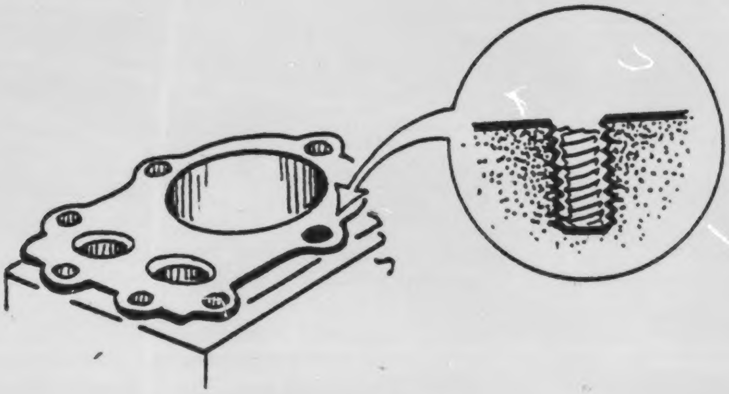
You have removed the broken stud and cleaned the threads so they can accept a new bolt.

INFORMATION

There are several ways to remove broken studs from an engine part. Some of them are: tap out with a punch; use a stud extractor; cut out with a torch; drill and tap. In this module, you will learn how to drill and tap out a broken stud. The drill and tap method is used if the stud is broken off even with or below the surface of the part.



When you drill the hole, you must be sure to choose the correct drill size for both the easy out set and the tap. Charts are available for quick reference. Your instructor will help you find one.

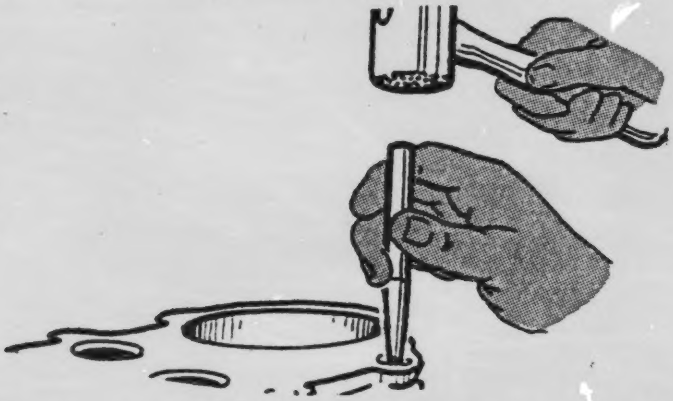


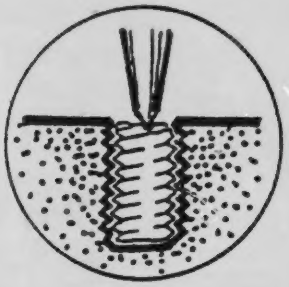
JOB STEPS

1. Look at the part from which you have to remove the broken stud. Try to determine the depth of the stud.

2. Measure the width of the broken stud.

3. Using center punch, center punch the end of the stud. Sometimes, if possible, it helps to file the end of the stud flat.

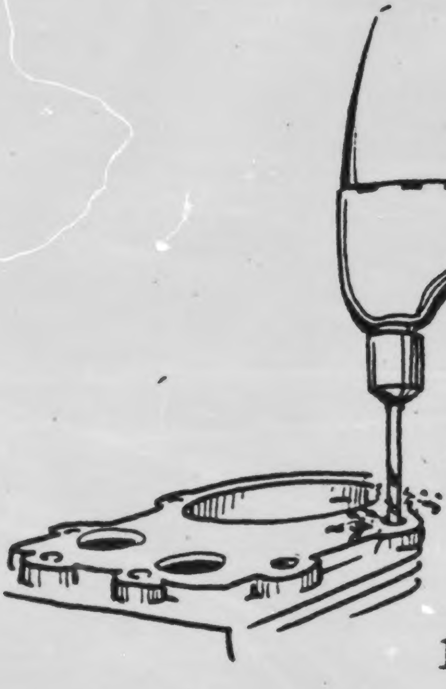


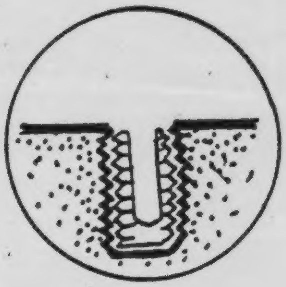


4. According to the size of the stud you must remove, find what size easy out you need.

5. Select the proper size drill bit for the easy out you have to use. (Check the right chart for these sizes.)

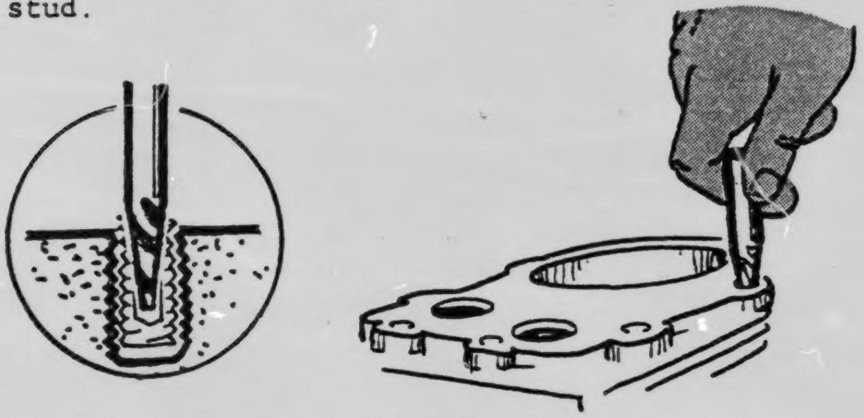
6. Using drill set, drill a hole in the center of the broken stud. Drill to at least 75% of the depth of the broken stud.



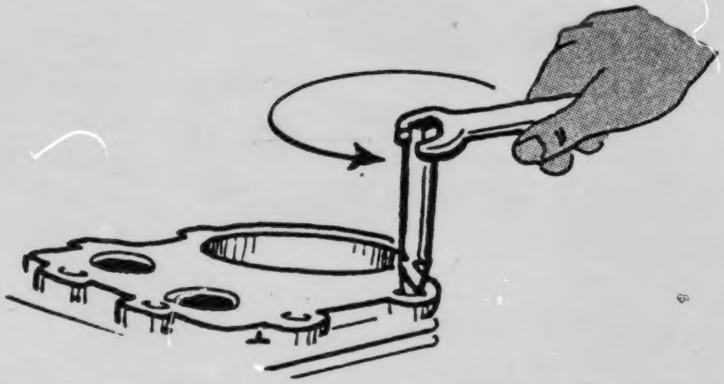


JOB STEPS

7. Turn the easy out into the hole you have just drilled. Make sure that the easy out has left-hand threads. As you turn the easy out inward, it tightens in the hole. It will twist out the broken stud.



8. Some easy outs are tapered. If yours is tapered, tap it into the hole. Using vice grips or a wrench, twist out the broken stud.



9. Using a thread gauge, find out what size threads are in the hole.

10. Select the proper tap and tap the threads out so they will be smooth.

11. Put the bolt in the refinished hole to be sure it fits properly.

12. Have your instructor check your work.

small engine repair

unit: Engine Block Machining & Tools

capital area career center

module: 7501 16 003 **date:** 5/77 **level:** I

skill title: Cylinder Hones--How to Identify Them and How They are Assembled

developed & written by: Jim Pitts

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

1. How to identify an AN and JN hone.
2. What each hone does.
3. What are different grit stones.
4. How to assemble the hone.

IN ORDER TO DO THIS YOU WILL NEED:

AN & JN hones

Hone stone sets

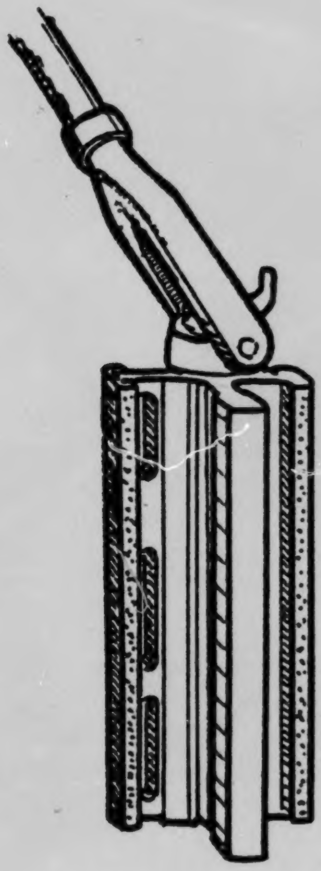
Manufacturer's instructions

WE WILL KNOW YOU CAN DO IT WHEN:

1. You can tell the difference between an AN and JN hone.
2. You understand what each one does.
3. You learn what the different grit stones are.
4. You can assemble the hones.

INFORMATION

We use two different kinds of hone assemblies. One is model JN, shown below.

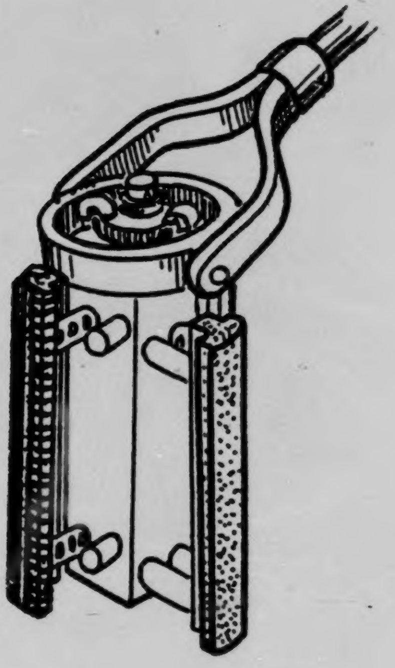


WORD GUIDE

ADDITIONAL -	Extra
LUBRICANTS -	Something which cuts down on friction, like grease.

INFORMATION

The other one is a model AN hone.



The difference between the two hones is in the diameter of each one. The AN hone is used for smaller cylinders. As you will see, they also assemble differently.

There are two kinds of hone stones. Wet stones require an additional lubricant used with them. The stone manufacturer will tell you which lubricant to use (oil and kerosene are two common lubricants).

INFORMATION

There are three types of stones which are grouped according to their grit. Grit is the coarseness or fineness of the stone abrasive. Coarse grit stones are used for cast iron or steel cylinder walls. Fine grit stones can also be used for cast iron or steel cylinder walls to provide a smooth finish. Very fine stones must be used on aluminum. A lubricant is always used when honing aluminum cylinder walls.

If you are using the model JN hone, use:

JN 100 - Coarse stones
JN 200 - Fine stones
JN 300 - Very fine stones

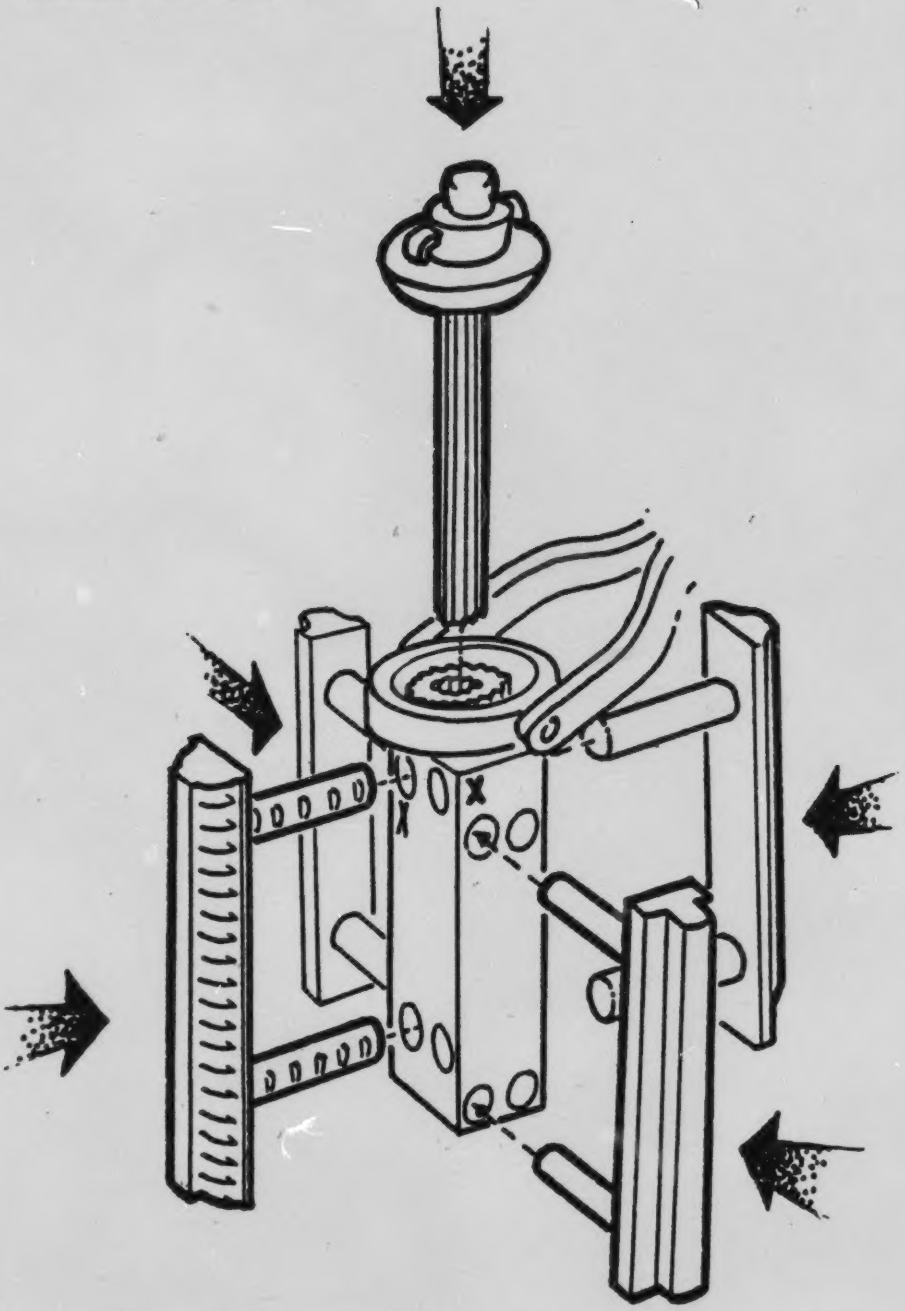
If you are using the model AN hone, use:

AN 100 - Coarse stones
AN 200 - Fine stones
AN 500 - Very fine stones

If you do not know the kind of metal of which the cylinder wall is made, check with your instructor.

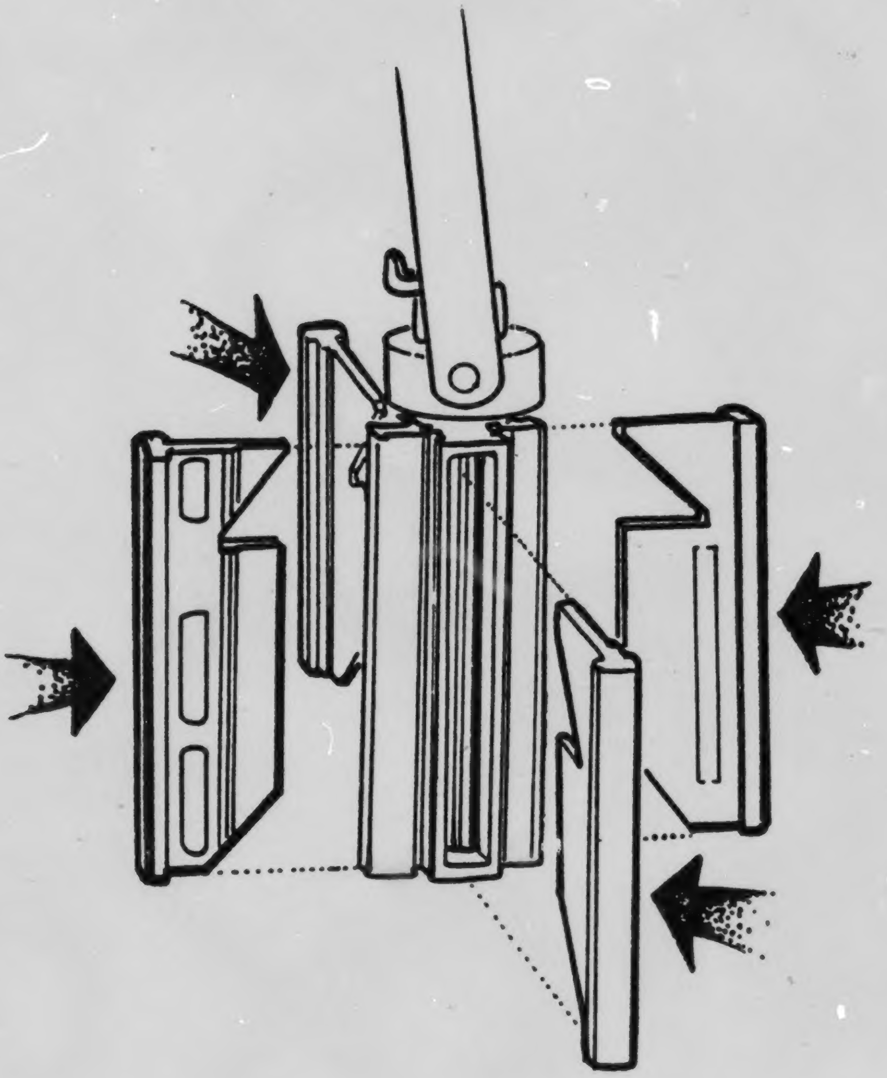
JOB STEPS

1. Get all equipment and go to your work area.
2. Following the instructions on the top of the box, assemble the model JN hone. The picture below will show how the stones fit in.



JOB STEPS

3. Following the instructions on the top of the box, assemble the AN hone. The pictures below will help you.



4. Ask your instructor to check both hones. He will make sure you know which hone to use and which stone is used for cast iron or aluminum.

small engine repair

unit: Engine Block Machining and Tools

capital area career center

module: 7501 16 004 date: 7/77 level: I

skill title: How to Hone Cylinders Using Hones JN and AN Models

developed & written by: Jim Pitts

visuals by: Dave Wehrwein

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PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to hone cylinders using model JN or AN hones.

IN ORDER TO DO THIS YOU WILL NEED:

A block, either aluminum, steel sleeve, or cast iron

A ½" drill motor or a drill press

A JN or AN hone set

Feeler gauges

C-clamp

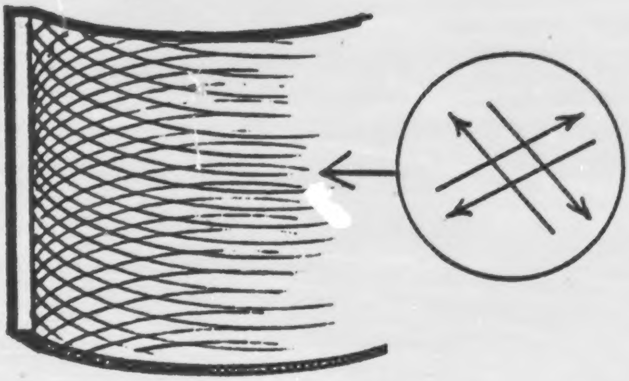
Lubricant

WE WILL KNOW YOU CAN DO IT WHEN:

You have honed the cylinder so it is clean and the piston fits properly with the model JN or AN hone.

INFORMATION

Honing is an abrasive (sandpaper-like) finishing process which removes boring tool marks and surface scratches. Honing also produces a rimform finish in the cylinder wall. If the cylinder wall is honed properly, the wall will.wear smoothly as the rings are broken in. This will help the rings to last longer. The engine cylinder is honed as the picture below shows.



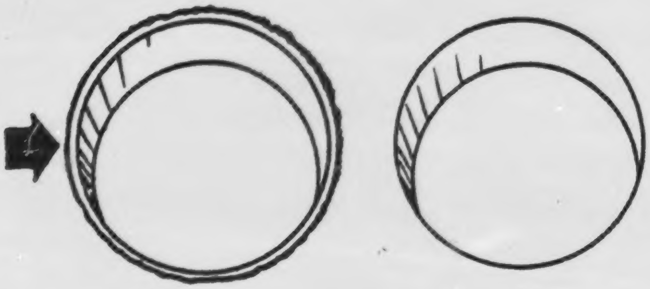
If the cylinder is honed properly, a fine cross-hatched surface will appear.

JOB STEPS

1. Get all material and go to your work area.
2. Ask your instructor to give you an engine block to have.

   NOTE: If you are going to use a lubricant, get it now. You will use the lubricant which your instructor chooses.

3. If the block is cast iron, there is no problem. If the block is aluminum, then you have to decide if it has a steel sleeve bore, or an aluminum bore. Look at the top of the cylinder; clean it on a wire brush if needed, so you can see if it has a dark ring.
4. To decide if the aluminum block has a steel sleeve or aluminum bore, clean the top of the cylinder on a wire brush and notice if the cylinder top has a dark ring around it. If so, the cylinder has a steel sleeve bore.



NOTE: If using a cast iron block, you do not need to worry about sleeve.

WORD GUIDE

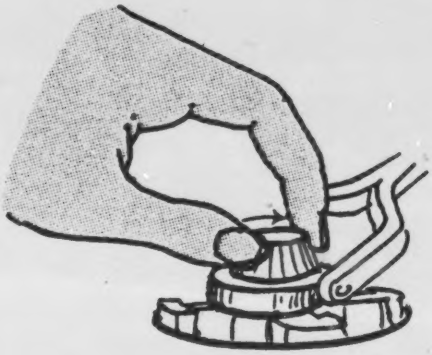
CLOCKWISE - To the right, like hands moving on a clock.

JOB STEPS

5. Now, very carefully clamp the block down to a bench. Have your instructor check your work.

6. Install the hone in the cylinder far enough so that you can still get to the hone adjusting nut. (See picture on Job Step #17)

7. Now, turn the adjusting knob clockwise to expand the stones out to the cylinder walls. Don't make it tight.



NOTE: When the hone is adjusted properly, it will drag evenly, up and down. It will not shake or rattle in the bore.

JOB STEPS

8. Now you can put the electric drill motor on the hone. Be sure the drill motor is not plugged in at this time. Also be sure that the trigger is not locked in the ON position.

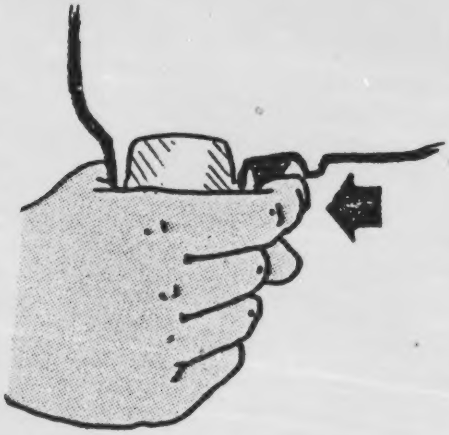
9. Check to see if the chuck of the drill is tight on the hone shaft.

CAUTION: You must be very careful because this can be a dangerous job. IF THIS IS YOUR FIRST TIME, HAVE THE INSTRUCTOR GO OVER THIS SECTION BEFORE YOU START!!!

10. After checking to be sure that the trigger is not locked on, you should plug the cord into the wall.

11. Firmly grasp the drill motor with both hands, keeping your finger off of the trigger.

12. Put your finger on the trigger but don't squeeze it yet. When you squeeze, do it for just a second and release it to get the feel of the pressure of the stones against the cylinder walls.

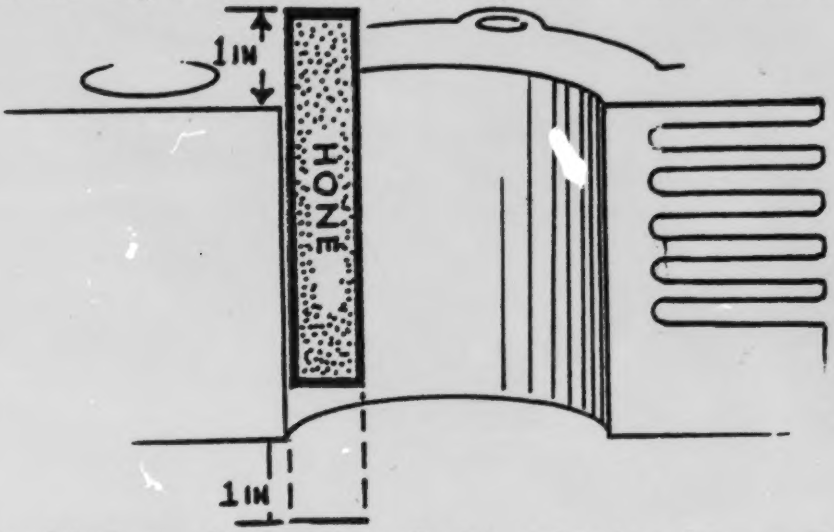


WARNING! If the pressure is too great against the cylinder walls, the drill will try to turn and twist out of your hand.

13. If you feel you can control the drill and the pressure isn't too great, you can now hold the trigger on and, at the same

JOB STEPS

time, stroke the drill up and down. Do not let the hone come out the top or bottom of the cylinder more than one inch.



14. Start stroking at the bottom of the cylinder (or at the least worn section of the cylinder.

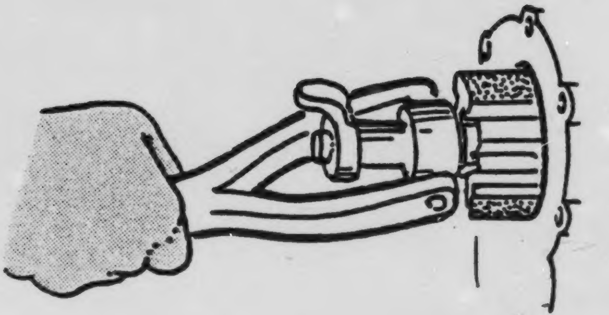
15. Using short strokes to concentrate honing in the smallest diameter, allow the stones to go through the lower end of the bore approximately one inch. Gradually lengthen the stroke as metal is removed and stones contact higher on cylinder walls.

NOTE: As you are stroking, you may notice a reduction in drill speed. If this happens, it means the diameter is smaller and you should concentrate your honing at this area until the drill speed is constant over 75% of the cylinder length. Then, stroke the full length of the cylinder at a rate of about 30 complete strokes per minute.

JOB STEPS

16. When the bore is clean and the hone has an even drag over the full length of the bore, shut off the drill.

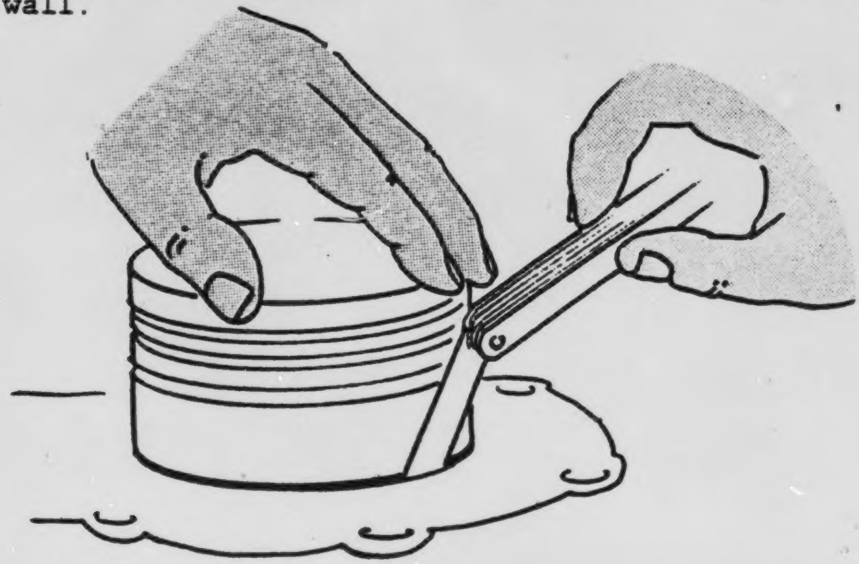
17. Take the hone out of the bore.



JOB STEPS

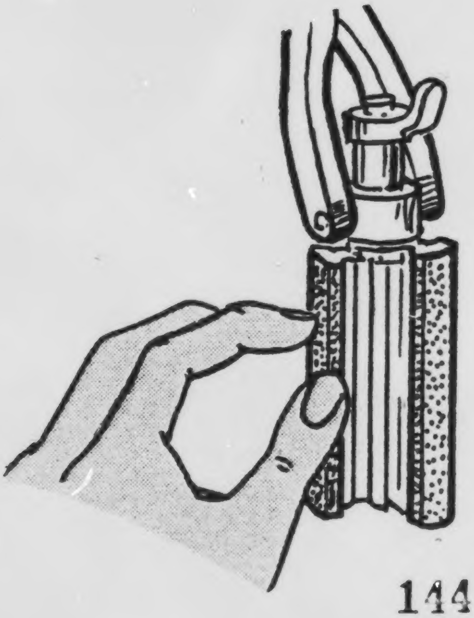
18. Using a rag, clean out the cylinder bore.

19. Try to install the piston into the cylinder. If it goes in, check the clearance between the piston skirt and the cylinder wall.



20. If not, repeat Steps 12-16 until you have .003 skirt clearance on an aluminum cylinder. Then, clean up the block and you are done.

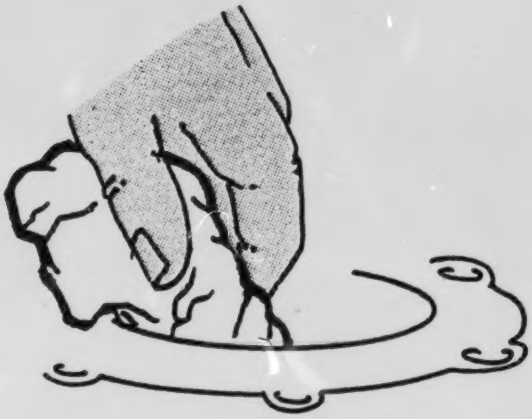
21. If you are honing a cast iron or steel sleeve, when you reach .003, you will have to install the finishing stone set.



JOB STEPS

22. Install finishing stone set AN200 or JN200 and repeat steps 12-18 until you have .005 piston skirt clearance.

23. Clean the cylinder and block thoroughly in oleum. Keep running a clean rag through the cylinder until it can be run through and come out clean.



24. Ask your instructor to inspect the job and approve it.

small engine repair

unit: Engine Block Machining and Tools

capital area career center

module: 7501 16 005 **date:** 4/16/77 **level:** I

skill title: How to use a torque wrench

developed & written by: Daniel M. Woodward

visuals by: Dave Wehrwein

WORD GUIDE

SPECIFICATIONS - Manufacturers directions or description.

PERFORMANCE OBJECTIVE

You are going to learn:

How to use a torque wrench to tighten bolts.

And in order to do this you will need:

A torque wrench

Socket to fit wrench drive

Engine block with the head in place

We will know you can do it when:

You have completed the job steps and tightened the head on the engine to the correct specifications.

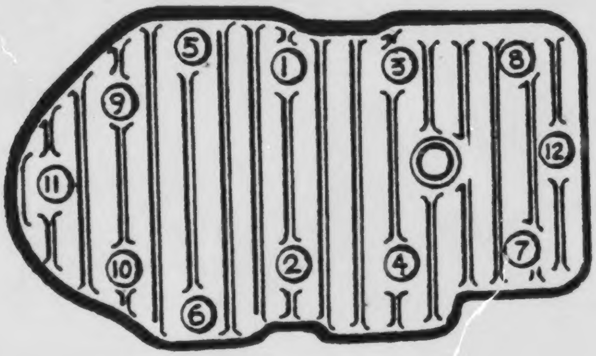
INFORMATION

With a torque wrench, you can properly tighten a bolt or nut according to specifications.

Engine-producers set certain limits on nut and bolt-tightness. You can ruin engines by not following these specifications.

There is a correct way to tighten down a cylinder head. Start from the middle and go outward.

Follow the numbers on the cylinder head below!



Some torque wrenches are larger than others. This could mean that the smaller wrench is for "INCH POUNDS OF TIGHTNESS" and that the larger wrench is for "FOOT POUNDS OF TIGHTNESS". Most small-engine instructions are in "INCH POUNDS". A "FOOT POUND" is 12 times more torque than an inch pound. 10 foot pounds would be the same tightness as 120 inch pounds.

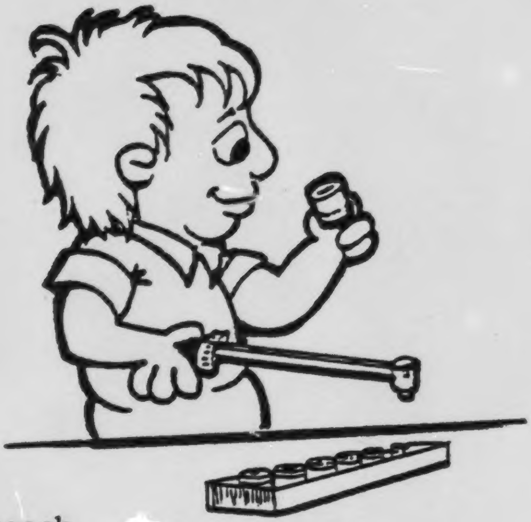
JOB STEPS

1. Get your torque wrench and go to your work area.

2. Find out the torque for the Cylinder Head bolts on your engine.

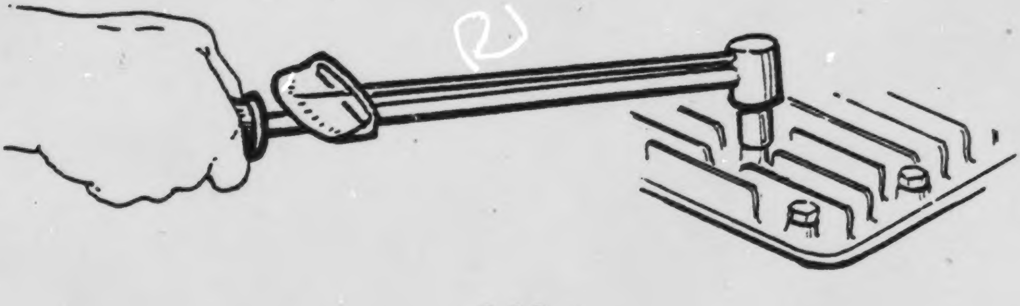
   NOTE: They are usually around 140 to 180 "inch pounds". Check your service manual.

3. Select the correct socket for the head bolt.



4. Place socket onto the torque wrench.

5. Place one hand on the handle of the torque wrench and the other hand on the head of the wrench. Then, loosen the cylinder head bolts.



JOB STEPS

6. Using the correct tightening order (from the information section of this module), tighten all cylinder head bolts to 60 "inch pounds."

7. Tighten all cylinder head bolts to 100 "inch pounds" (again using the correct tightening order).

8. Finish tightening to the correct service manual specifications.

9. Practice with the wrench until you feel you know how to use it properly.

10. Put each tool in its proper place.

small engine repair

unit: Engine Block Machining and Tools

capital area career center

module: 75C1 16 006 **date:** 4/16/77 **level:** I

skill title: How to Operate an Electric Impact Wrench

developed & written by: Daniel M. Woodward

visuals by: Dave Wehrwein

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WORD GUIDE

TORQUE - Exact tightness.

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to correctly use an electric impact wrench.

IN ORDER TO DO THIS YOU WILL NEED:

Electric Impact Wrench

1/2 inch drive socket set

Engine block with the head and bolts in place

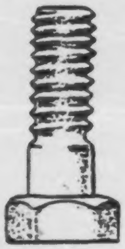
WE WILL KNOW YOU CAN DO IT WHEN:

You have completed the job steps by correctly using an electric powered impact wrench.

INFORMATION

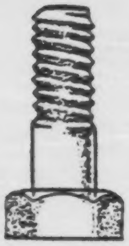
Before removing any bolt with an electric impact wrench, you must know in which direction to turn the bolt. Otherwise, you can break the bolt.

Lay a bolt on its side: If its threads lean towards the left, it is a right-hand thread.



If the threads lean toward the right, it is a left-hand thread.

NOTE: If you are not sure of the direction of the threads, check with your instructor.



Most threads are right-hand threads, but occasionally you will see a left-hand thread on a moving part, such as a crankshaft end.

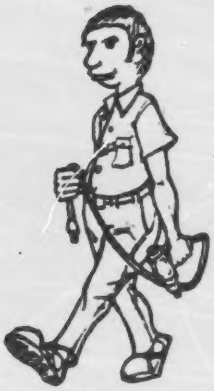
Make sure you have the impact wrench set according to the type of thread. If you have a right-hand thread, set the wrench "reverse". If you have a left-hand thread, set it on "forward".

On some electric impact wrenches, turn the dial at the rear. If you want to loosen a right-hand thread, turn the dial clockwise.

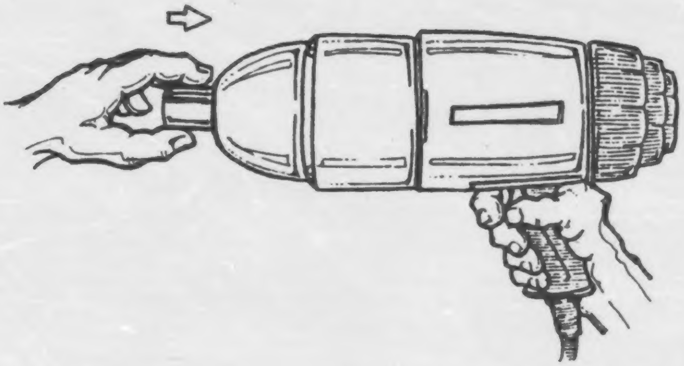
NOTE: Do not use an impact wrench to torque a bolt down. You should use a hand torque wrench when putting anything back together.

JOB STEPS

1. Get an electric impact wrench and go to your work area.



2. Choose the correct size socket for the head bolts and push the socket onto impact driver.



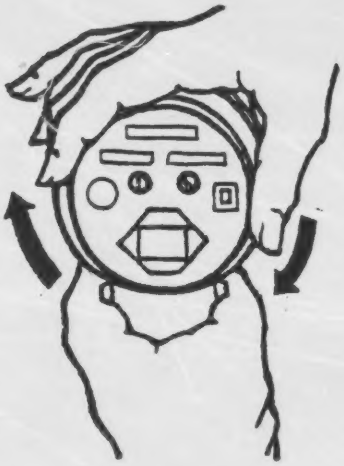
WORD GUIDE

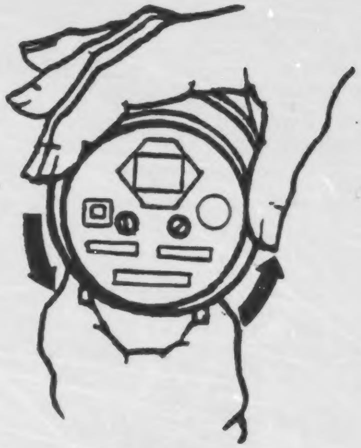
CLOCKWISE - To the right.

COUNTER-CLOCKWISE - To the left.

JOB STEPS

3. Plug impact driver into outlet, then turn the direction control clockwise for a right-hand thread or counter-clockwise for a left-hand thread.





4. Place the wrench on the bolt head.

5. Hold tightly and pull the trigger on the wrench.

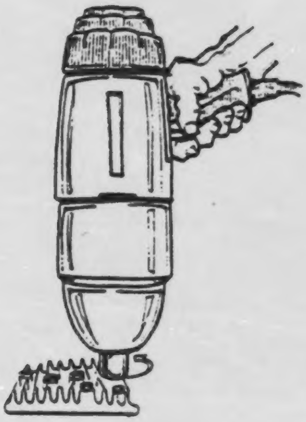
   NOTE: If the bolt or nut does not come loose, change the Direction-Control dial and pull the trigger. This may loosen it up.

6. Loosen all the head bolts.

7. Replace all of the head bolts.

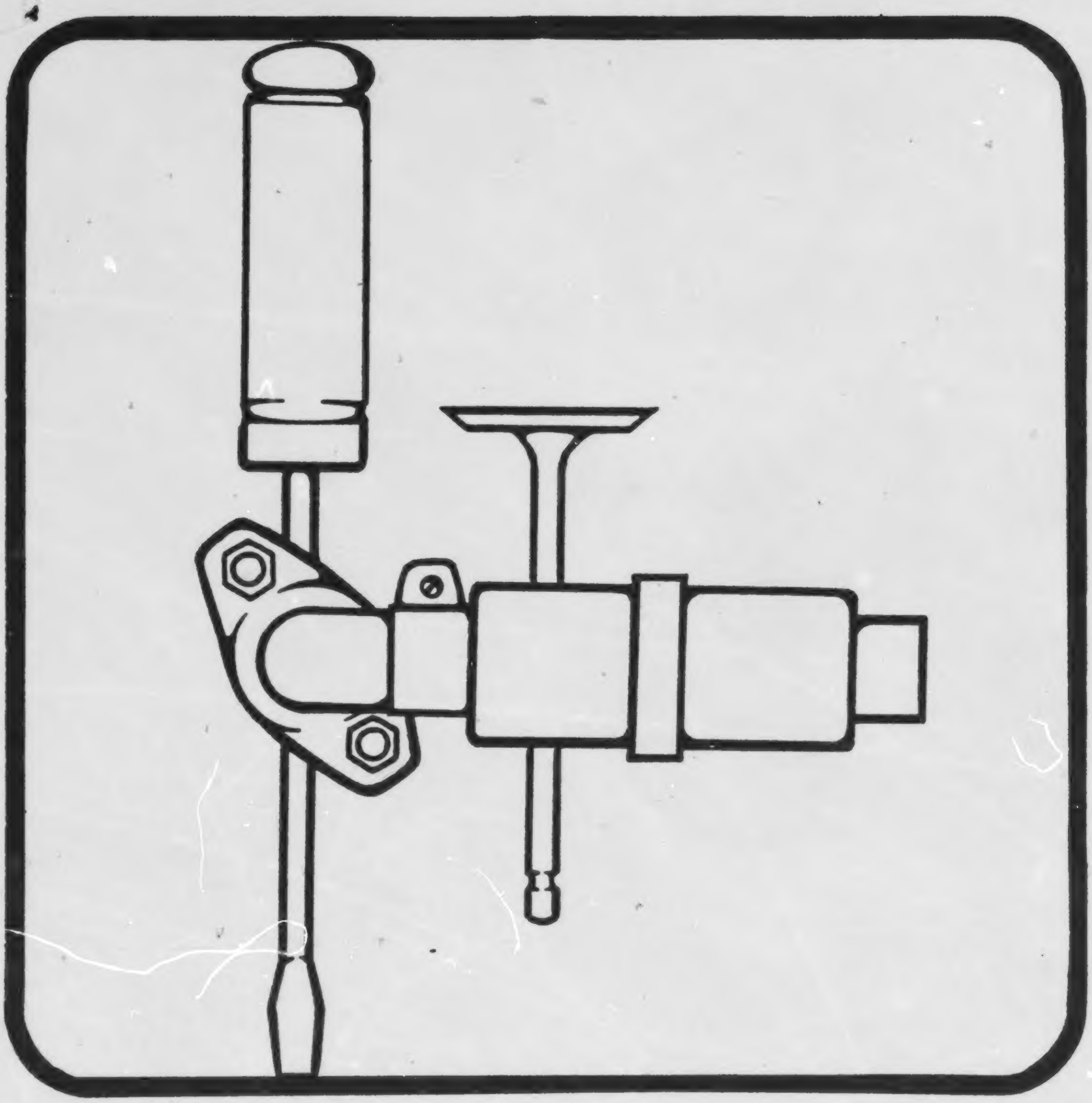
JOB STEPS

8. Run the head bolts down, but do not tighten.



9. Use a torque wrench to tighten correctly.

10. Return each tool to its proper place.



small engine repair

unit: MACHINING

capital area career center

module: 7501 16 007 **date:** April 1977 **level:** I

skill title: How to Use an Air Impact Wrench

developed & written by: Daniel M. Woodward

visuals by: Dave Wehrwein 157

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to correctly use an air-powered impact wrench.

IN ORDER TO DO THIS YOU WILL NEED:

An air supply

An air impact wrench

An engine block with the head in place

WE WILL KNOW YOU CAN DO IT WHEN:

You have completed the job steps correctly by loosening the head bolts at different settings on the impact wrench.

INFORMATION

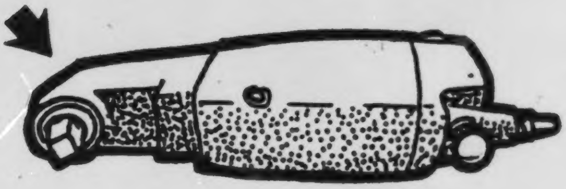
With an impact wrench, you can adjust the amount of impact. It also has a right angle (90°) head so it more easily gets into tight areas.

You should not use oversize, worn or cracked sockets. If the impact wrench does not loosen a bolt or nut in 3 to 5 seconds, get a larger wrench.

NOTE: You should always use the simplest socket hook-up.

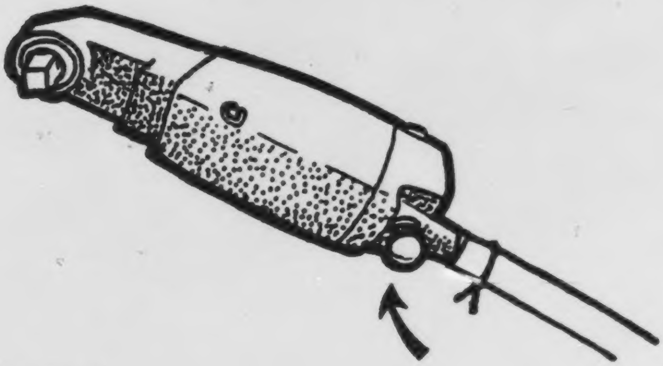
JOB STEPS

1. Take the air impact wrench and place the right angle drive head on it.



2. Attach the wrench to the air supply line.

3. Locate the air pressure control knob.

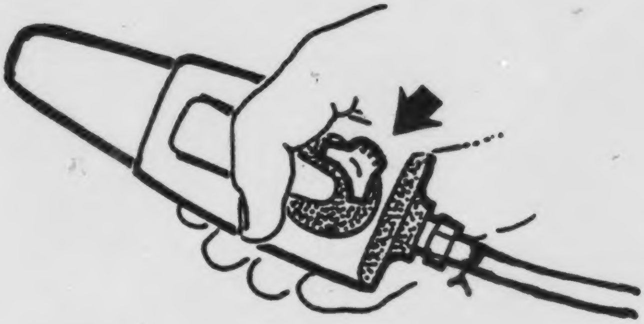


4. Turn the knob to "1".

5. Place the correct socket on the wrench.

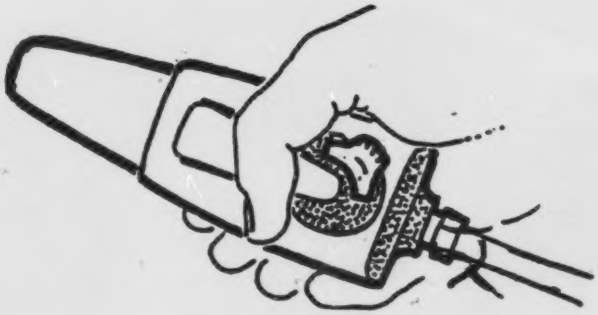
JOB STEPS

6. Push the reverse-forward lever to "R".

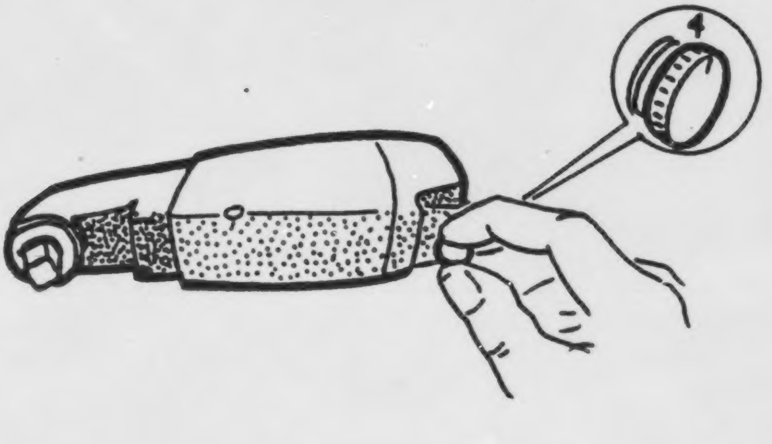


7. Place the wrench and socket on the head bolt.

8. Push trigger down and loosen the bolt.



9. Turn the air pressure control knob to "4".



JOB STEPS

10. Push the trigger down and loosen the head bolt.

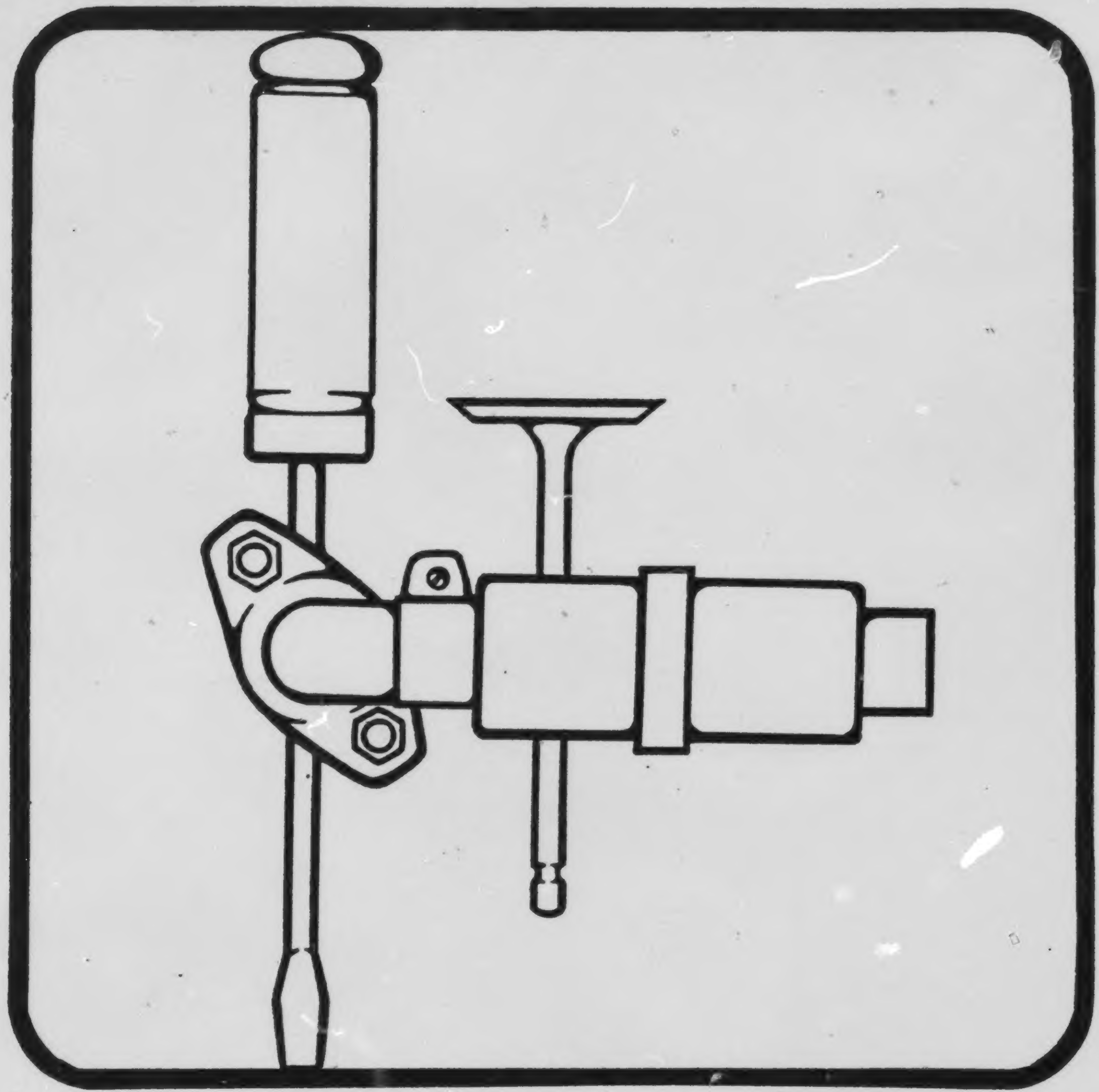
11. Turn the air pressure control knob to "7".

12. Loosen another head bolt.

    NOTE: As you turn the air pressure control knob up, more pressure is applied on the head bolt.

13. Try different settings and loosen the remaining head bolts.

14. Return each tool to it's proper place.



small engine repair

unit: ENGINE BLOCK MACHINING AND TOOLS

capital area career center

module: 7501 16 008 **date:** May 1977 **level:** I

skill title: How to Use an Air Ratchet Wrench

developed & written by: Daniel M. Woodward

visuals by: Sandra Starnaman

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to use an air-powered ratchet wrench to loosen and tighten a bolt.

IN ORDER TO DO THIS YOU WILL NEED:

An air supply

An air ratchet wrench

An engine block with the cylinder head in place

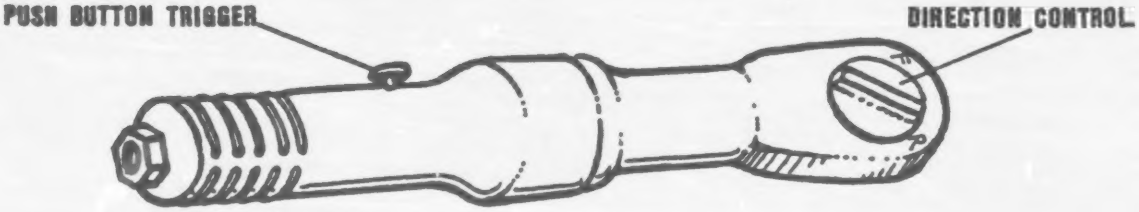
WE WILL KNOW YOU CAN DO IT WHEN:

You have completed the job steps and successfully loosened and tightened a bolt with the air ratchet wrench.

INFORMATION

We use this type of air-powered ratchet wrench to save us time and energy.

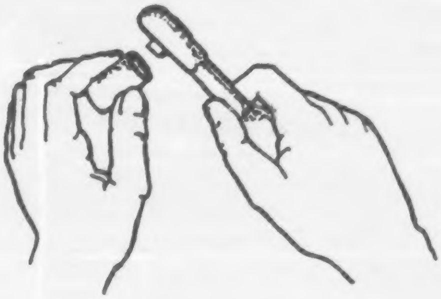
An impact wrench has much more power than an air ratchet wrench for breaking tight nuts and bolts. When you use an air ratchet wrench, you first loosen the tight nut or bolt with your hand, then continue loosening the nut or bolt with the wrench. Also tighten by hand after you have used the air ratchet wrench to turn it back on.



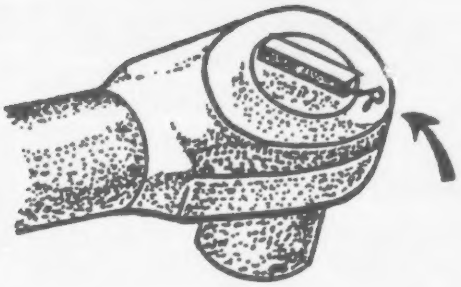
JOB STEPS

1. Pick up engine block and air ratchet wrench and go to a work area that has an air supply line.

2. Pick the correct socket that matches the head bolt on the engine.
3. Push the socket onto the wrench.

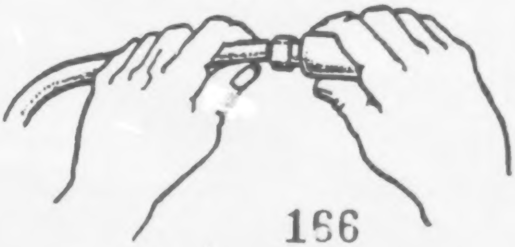


4. Turn the control on the head of the wrench to (R) for reverse.



NOTE: (R) is for reverse and loosening a bolt and (F) is for forward or tightening.

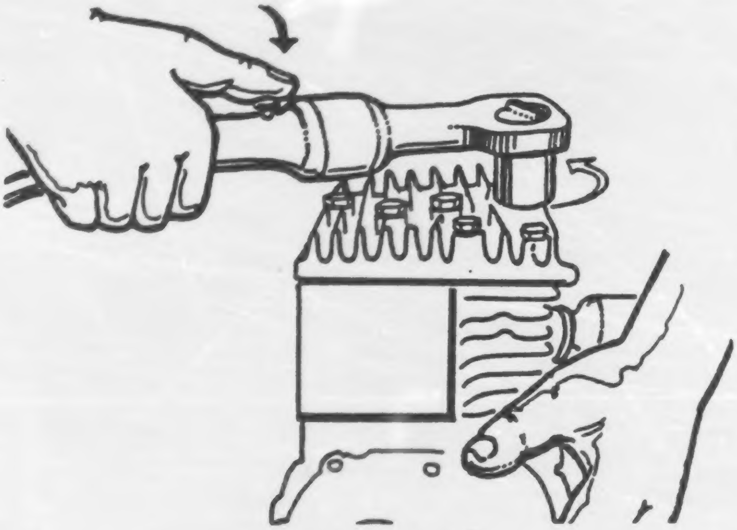
5. Put wrench onto air supply line.



JOB STEPS

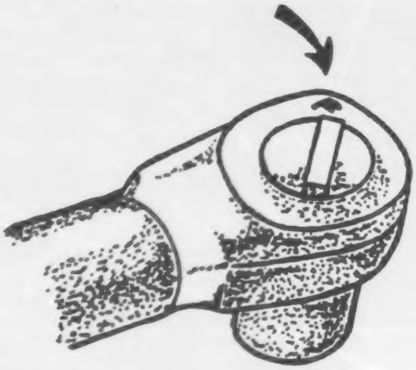
6. Holding the engine or block firmly, place the wrench on the bolt. Then, pull or push to break the bolt loose from the threads on the engine block.

7. Using your hand, push the botton trigger and remove the bolt.



8. Remove all of the head bolts.

9. Turn the control on the head of the wrench to "F" (forward).

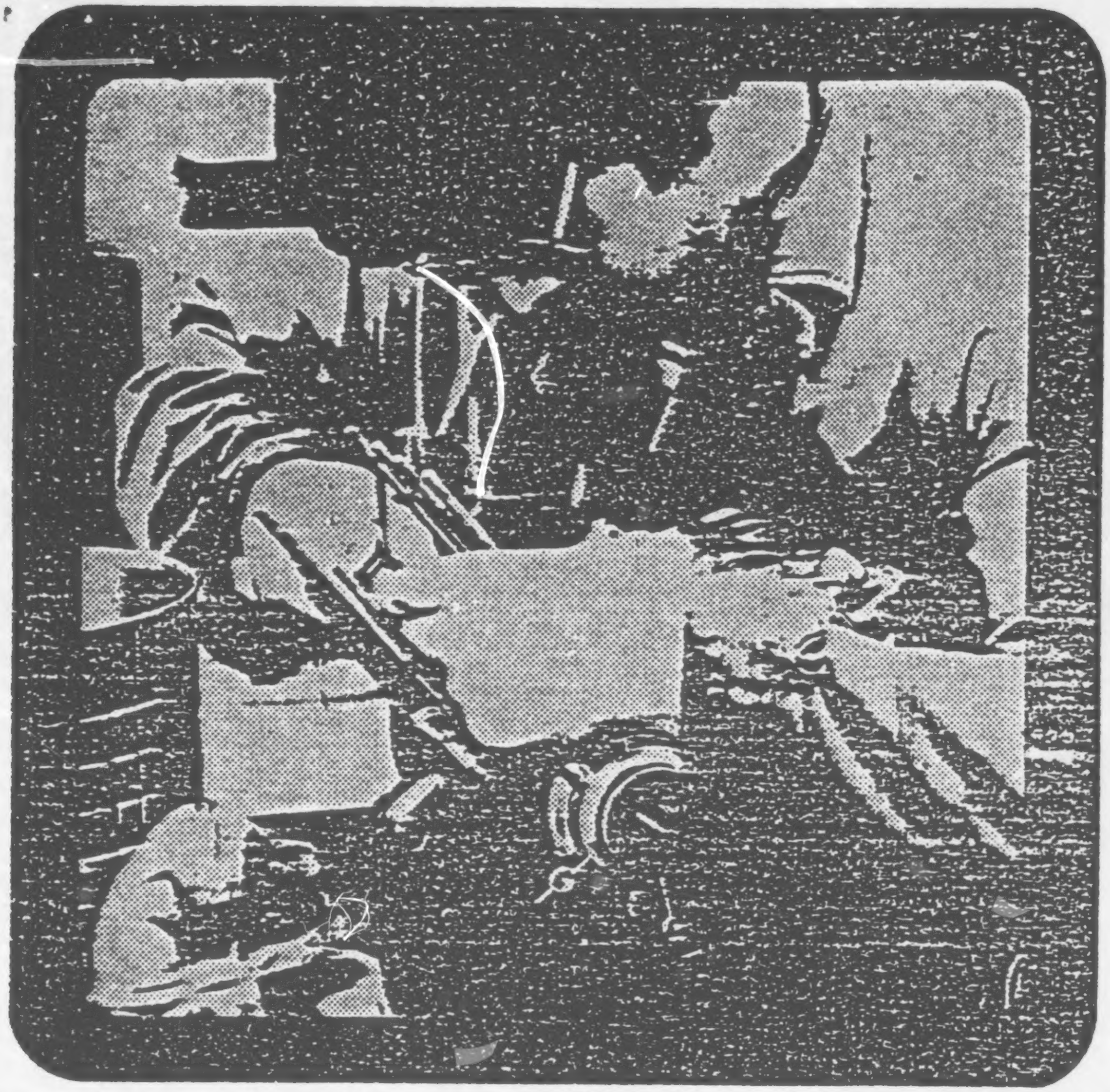


10. Place the head bolts back into the head.

11. Using the wrench, tighten the bolts.

12. Take the air ratchet wrench off the air supply line.

13. Return each tool to its proper place.



small engine repair

unit: Tune-Up

capital area career center

module: 7501 18 001 date: 1/75 level: IV

skill title: Minor Tune-Up on air-cooled engine (2-or 4-cycle)

developed & written by: Jim Pitts & Don Foster

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

You are going to learn:

How to tune-up a 2-or 4-cycle, air-cooled engine.

And in order to do this you will need:

Tools

2-or 4-cycle, air-cooled engine

Mercotronic tester

Necessary replacement parts

Torque wrench

We will know you can do it when:

A. You can start the engine you have tuned in 3 pulls.

B. The engine runs and idles up to maximum specified RPMs.

INFORMATION

There are many different kinds of mowers. You will have to get the specific manual for the kind of mower on which you are working.

A tune-up includes:

Cleaning the carburetor and gas tank.

Cleaning the carbon from the head and valves and piston.

Changing the oil.

Checking the magneto (and timing if necessary).

Checking the valves and seats.

Cleaning the air filter.

Changing the points and condenser.

Torquing the head bolts.

Adjusting the throttle.

Adjusting the governor.

Cleaning the mower.

NOTE: As you find worn or broken parts, make a list so that you can order new ones.

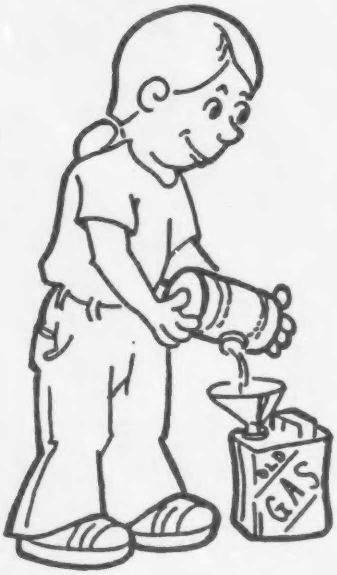
JOB STEPS

1. Put on your safety glasses and go to your work area.

2. Remove the engine from the mounts, as you learned in modules 7501 15 005, 7501 15 003, 7501 15 002.

3. Remove the carburetor and fuel tank, as you learned in modules 7501 04 001, 7501 05 005

4. Drain the fuel tank and clean the filter screen if it has one. 7501 04 001.



5. Overhaul the carburetor, as you learned in modules 7501 05 001 7501 05 002, 7501 05 003, 7501 05 004.

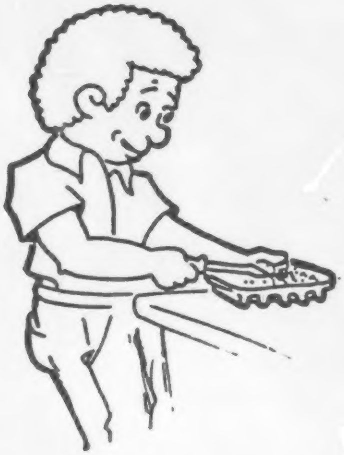
6. Drain the oil.

7. Remove the head, as you learned in module 7501 01 003.

JOB STEPS

8. Clean carbon from the head, valves, and piston, then check valves to see if they should be ground. If so, do a major tune-up.

   NOTE: This will be more expensive so you should contact the customer before you do the job.



9. Remove the air housing.

10. Remove the flywheel. Remember: there is a proper way to do this for each different make of engine. (See module 7501 08 001).

11. Clean the magneto area.

12. Using mercotronic tester, check the magneto. Replace the points and condenser. Gap the points properly (See module 7501 08 002).

13. Time the magneto (if it is the type that needs timing). Follow the steps in module 7501 14 001.

JOB STEPS

14. Finish assembling the magneto. See module 7501 08 003.

15. Install the head. Using torque wrench, torque it, as shown in module 7501 16 005.

16. Clean the air filter, as you learned in module 7501 02 001.

17. Install the flywheel. Using torque wrench, torque it. You will have to find the proper torque specifications in the service manual.

18. Replace the spark plug.

19. Install the air housing.

20. Install the fuel tank. Put gas in the fuel tank.

21. Put oil in the engine, as you learned in module 7501 09 001.

22. Start the engine and let it warm up. Shut off the engine.

23. Check the torque on the head bolts (see module 7501 01 003).

JOB STEPS

24. Start the engine and adjust the throttle control. Adjust the carburetor idle and high speed jets. (Refer to module 7501 05 001).

25. Adjust the governor according to manufacturer's specifications. (See module 7501 05 006).

26. Clean up the unit.

27. Have the instructor inspect your work.

small engine repair

unit: Tune Up

capital area career center

module: 7501 18 002 date: 1/75 level: 4

skill title: Tune up engine on riding mower (minor)

developed & written by: Jim Pitts and Don Foster

visuals by:

PERFORMANCE OBJECTIVE

You are going to learn:

How to tune up an air cooled engine on a riding lawn mower.

And in order to do this you will need:

Neccessary replacement parts

Mercotronic tester

Hand tools

Torque wrench

We will know that you can do it when:

A. You can start the engine in 3 pulls, or if it has an electric start, you can start it easily.

B. The engine runs and idles up to maximum specified R.P.M.'s (as allowed by the blade-tip speed law).

INFORMATION

There are many different kinds of riding lawn mowers. You will have to get the specific manual for the kind of mower on which you are working.

A tune-up includes:

Cleaning the carburetor and gas tank
Cleaning the carbon out of the head and valves
Changing the oil
Checking the magnets (and timing, if necessary)
Replacing the spark plug
Checking the valves and seats
Cleaning the air filter
Changing the points and condenser
Torquing the head bolts
Adjusting the throttle
Adjusting the governor
Cleaning the mower

NOTE: As you find worn or broken parts, make a list so you can order new ones.

Job Steps

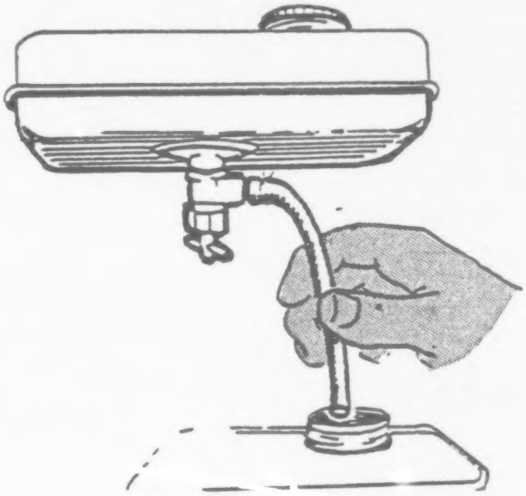
1. Put on your safety glasses and go to your work area.

2. Remove the hood (if it will get in the way).

3. Remove the carburetor, as you learned in module 5105 05 005.

4. Overhaul the carburetor, as you learned in modules:
    7501 05 001
    7501 05 002
    7501 05 003
    7501 05 004

5. Drain the fuel tank. Then, if it has one, clean the filter screen as you learned in module 7501 04 001.

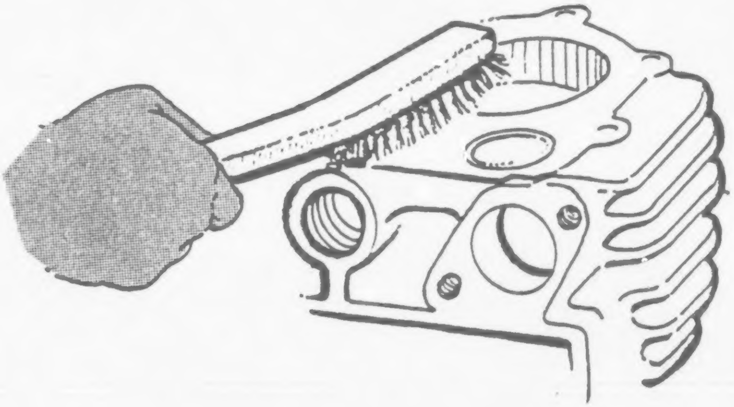


6. Drain the oil from the engine, as you learned in module 7501 09 001.

Job Steps

7. Remove the head, as you learned in module 7501 01 003.

8. Using carbon scraper and wire brush, clean the carbon from the head, piston, and valves. Then, check the valves to see if they should be ground. If so, do a major tune-up. This will be more expensive so you should contact the customer.



9. Remove the air housing.

10. Remove the flywheel. Remember: There is a proper way to do this for each different make of engine. (See Module 7501 08 009).

11. Clean the magneto area.

12. Using mercotronic tester, check the magneto. Replace the points and condenser. Gap points properly. (See module 7501 08 002).

13. Time the magneto (if it is the type that needs timing). Follow the steps in module 7501 14 001.

Job Steps

14. Finish assembling the magneto. (See module 7501 08 003).

15. Install the flywheel. Using torque wrench, torque it. You will have to find the proper torque specification in the service manual.

16. Clean the air filter, as you learned in module 7501 02 001.

17. Install the head. Using the torque wrench, torque it, as shown in module 7501 01 003.

18. Replace the spark plug. Install the carburetor, as you learned in module 7501 05 005.

19. Install the air housing.

20. Put oil in the engine, as you learned in module 7501 09 001.

21. Put gas in the fuel tank. Turn on the shut-off valve.

22. Start the engine and let it warm up. Shut off the engine.

23. Check the torque on the head bolts, as you learned in modules 7501 01 003.

24. Start the engine and adjust the throttle control, carburetor idle and high speed jets. (Refer to module 7501 05 007).

Job Steps

25. Adjust the governor, as you learned in module 7501 05 006.

26. Replace the hood.

27. Clean the mower.

28. Have the Instructor check your work.

small engine repair

unit: TUNE-UP

capital area career center

module: 7501 18 003 date: 3/77 level: IV

skill title: Tune-up Engine Chainsaw

developed & written by: Don Foster

visuals by: Dave Wehrwein

WORD GUIDE

UNDER LOAD - With saw stalled in a cut.

PERFORMANCE OBJECTIVE

You Are Going To Learn:

How to tune-up a chainsaw.

And In Order To Do This You Will Need:

Chainsaw

Set of tools

We Will Know You Can Do It When:

The engine will start in five pulls, the saw will run properly under load, and the chain will not run when the engine is at idle.

INFORMATION

Get the chainsaw manual and look up the specifications for the saw you are working on. Read as much as you can about the saw. Does magneto have to be timed? If yes, how?

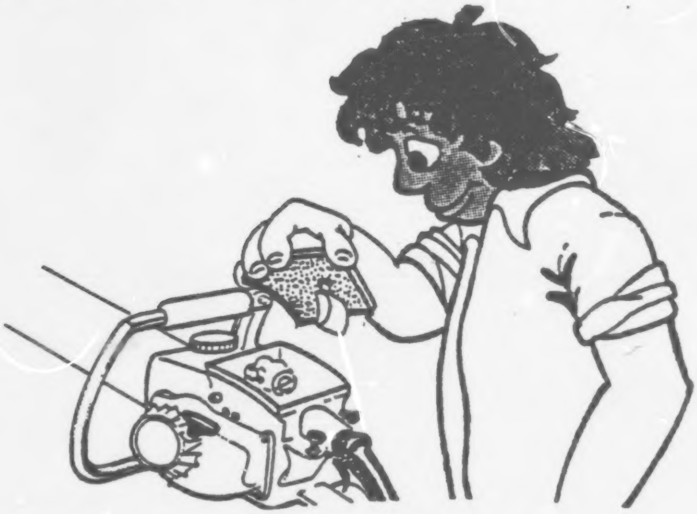
Remember what was done in other tune-ups and the order you did them in. Follow the steps.

Parts usually replaced in a tune-up are:

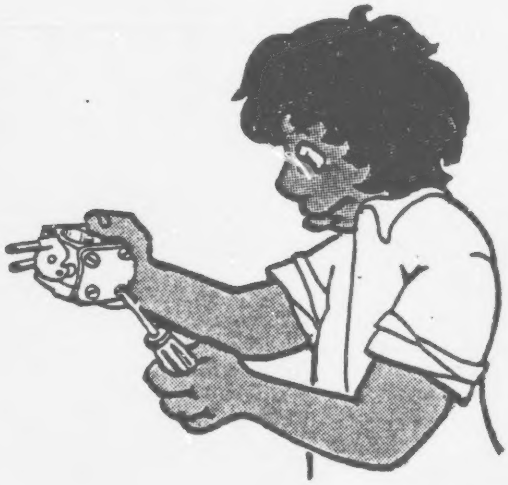
1. spark plug
2. point set
3. condenser
4. carburetor kit
5. any gaskets that have to be removed.

JOB STEPS

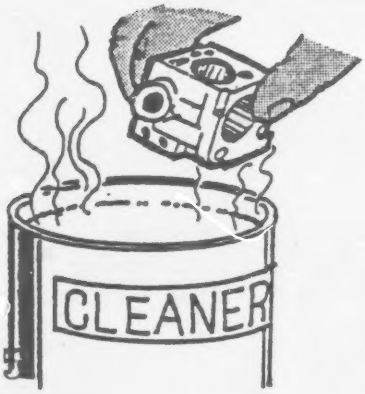
1. Remove the air filter. Check to be sure it is not too dirty.



2. Remove the carburetor and disassemble it.

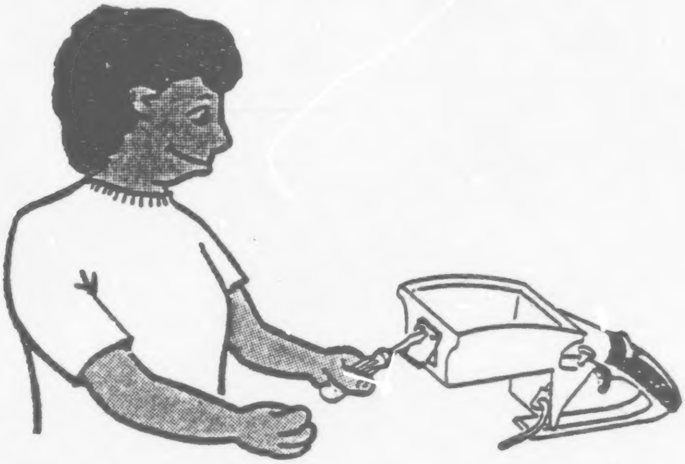


3. Put the carburetor in the cleaner.

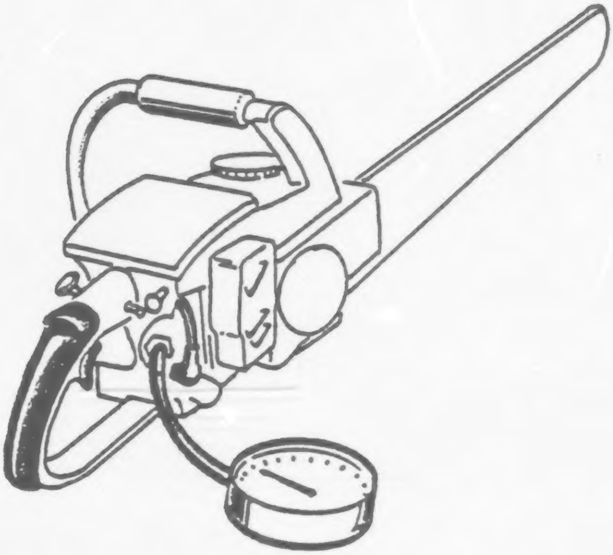


JOB STEPS

4. Check the reed plate assembly if there is one.

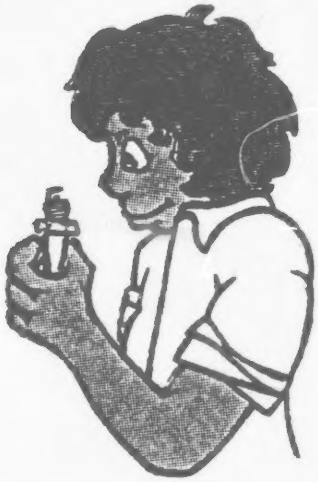


5. Take a compression check.



JOB STEPS

6. Disassemble the magneto and check the spark plug for wear and gap.

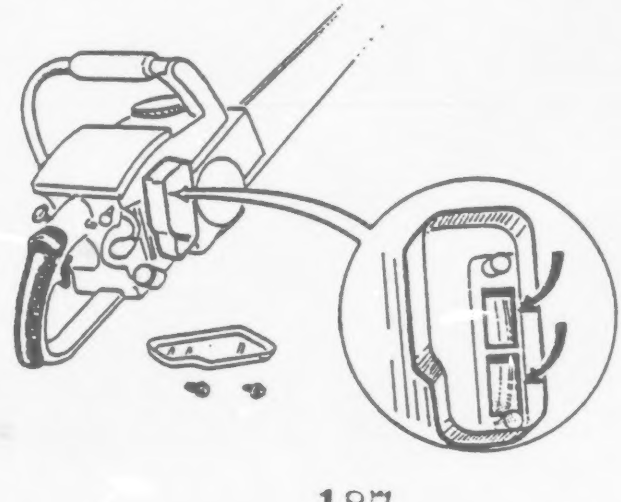


7. Check the coil and condenser.

8. Make a list of parts you will need and take the list to the parts department.

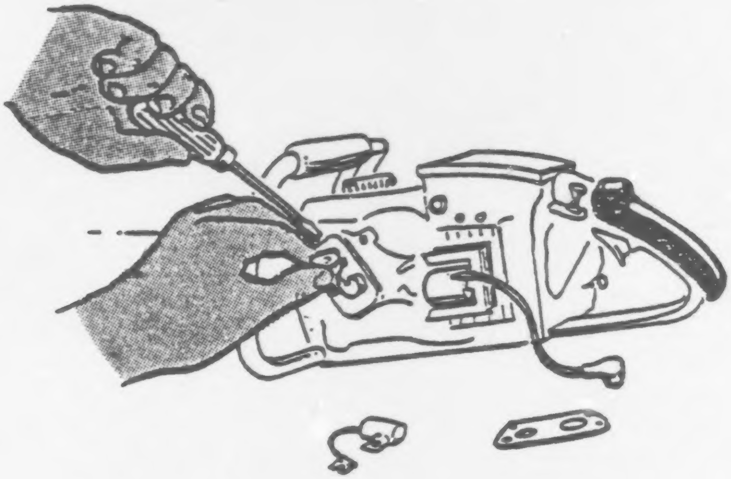
9. Go back to your bench and clean up the saw.

10. Be sure exhaust ports are clear.

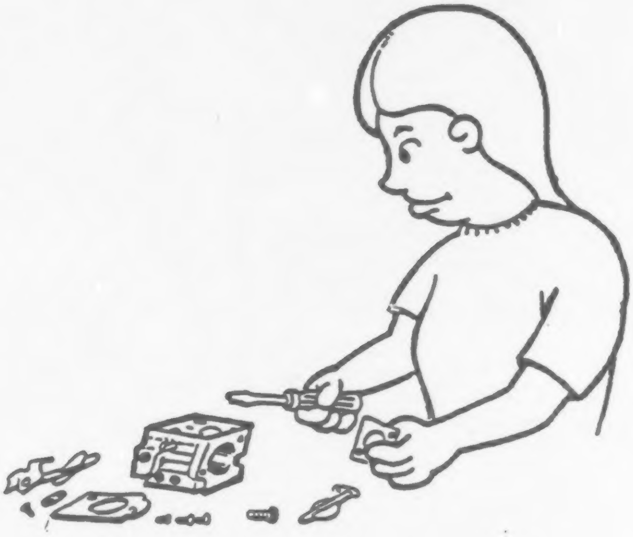


JOB STEPS

11. Install the points and condenser (re-time if needed).

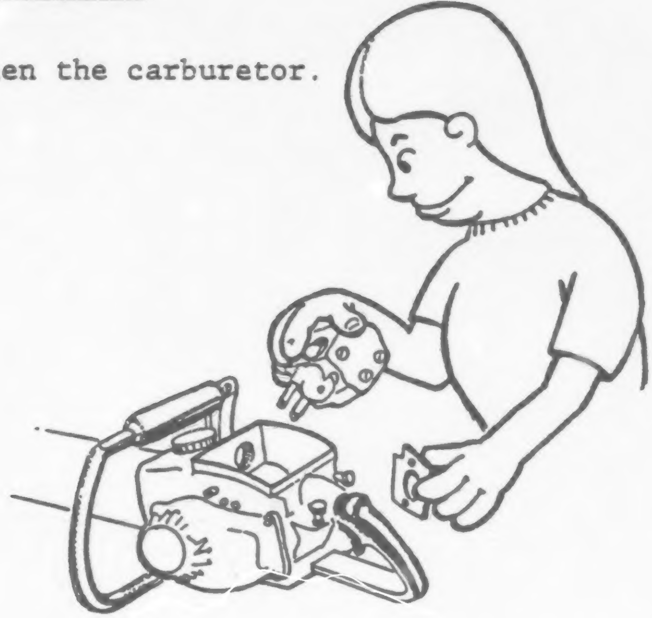


12. Install the reed plate if it was removed and assemble the carburetor. Install the carburetor kit.

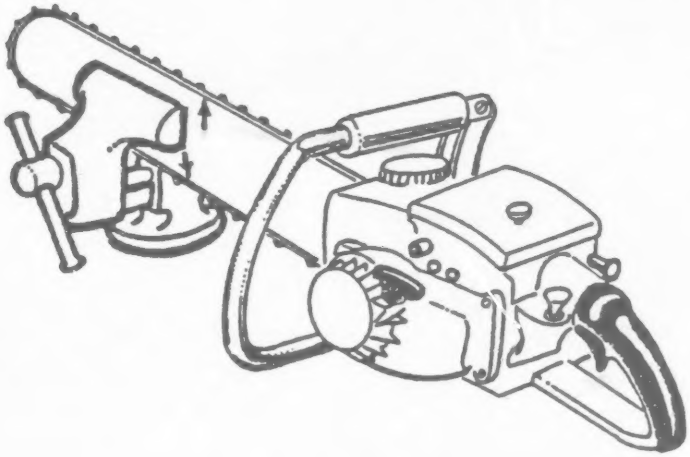


JOB STEPS

13. Install new gasket and then the carburetor.

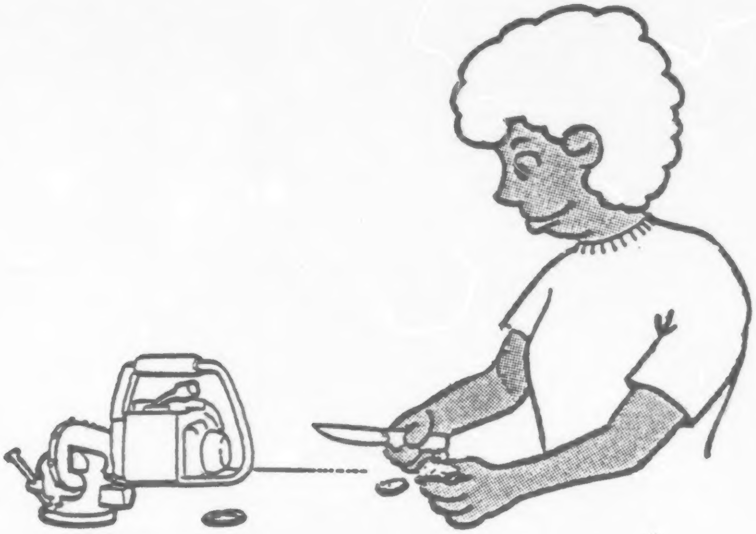


14. Clamp the saw in a vise, but be sure the chain isn't touching the vise.

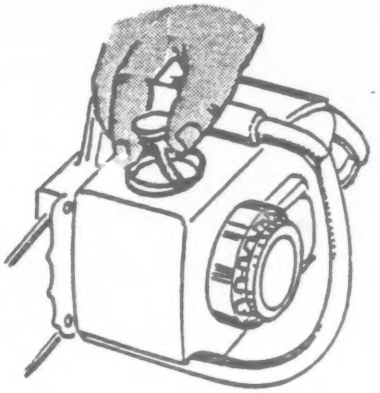


JOB STEPS

15. Remove the gas cap and pull out the internal gas line and fuel filter. Most of them have a cotton filter in the end of the line. Some of them have metal filters. Check this filter. If metal, try to blow through it.



16. Put the filter and gas line back in the tank.



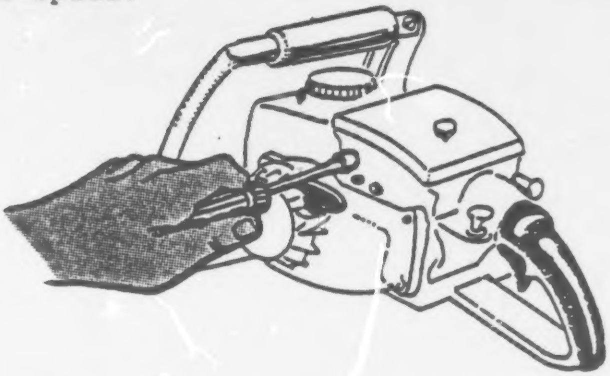
17. Fill with clean fuel.

JOB STEPS

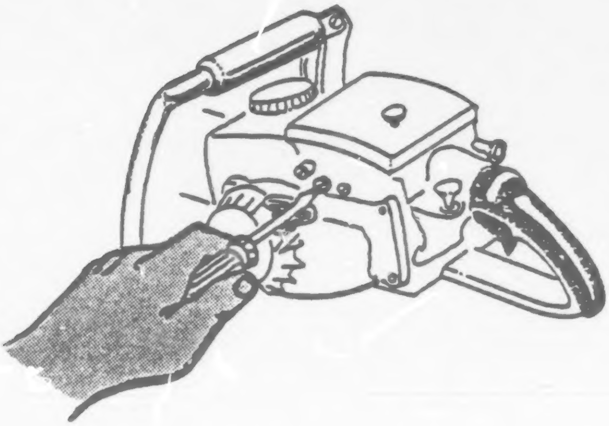
18. Be sure ignition switch is at the ON position.

19. Start and allow to warm up.

20. Adjust idle speed screw so engine runs just below clutch engagement speed.



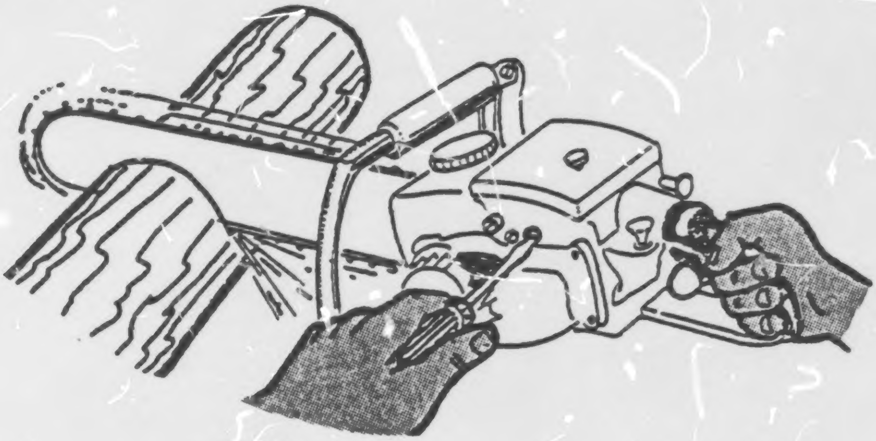
21. Then adjust idle fuel mixture needle so engine runs smoothly.



22. Remove saw from vise. Take saw to safe area or woodpile.

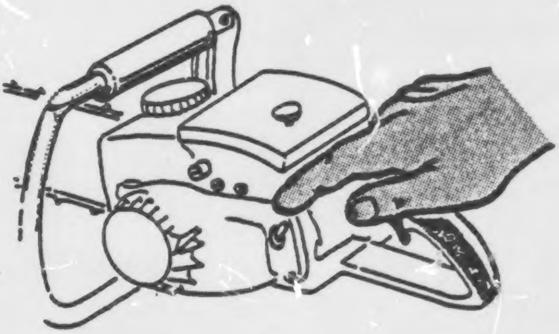
JOB STEPS

23. With engine at full throttle under load, adjust main fuel needle so engine runs at high speed without smoking.



24. Allow engine to idle. Re-adjust if necessary.

25. When saw operates smoothly turn it off.



small engine repair

unit: TUNE UP

capital area career center

module: 7501 18 004 date: 6/77 level: IV

skill title: Tune Up Engine, Snowmobile

developed & written by: Don Foster and Jim Pitts

visuals by: Dave Wehrwein

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PERFORMANCE OBJECTIVE

You are going to learn:

How to tune up an air-cooled, snowmobile engine.

And in order to do this you will need:

A snowmobile engine

Ohm meter or mercotronic tester

Necessary replacement parts

Compression tester (gauge)

Dynamometer

Torque wrench

We will know you can do this when:

1. You can start the engine within 5 pulls of starter handle.
2. You can keep the track from turning when mounted on the dynamometer.
3. You can adjust the track to maximum top speed while it's under load on the dynamometer.

INFORMATION

There are many different kinds of snowmobile engines. You will have to get the specific manual for the kind of snowmobile engine on which you will work.

A tune up includes:

1. Cleaning the carburetor and gas tank
2. Checking the magneto
3. Setting the tuning
4. Replacing the spark plug
5. Cleaning the points and condenser
6. Torquing the head bolts
7. Adjusting the throttle
8. Cleaning the snow machine

As you find worn or broken parts, list them so you can order new ones.

JOB STEPS

1. Get all equipment and go to your work area.

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****************************************
* CAUTION - Wear your safety glasses!  *
****************************************
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NOTE: Most snowmobile engines can be worked on without removing engine from the chasis.

2. Remove the carburetor (or carburetors), as you learned in module 7501 05 005.

3. Overhaul the carburetor, as you learned in modules:

   7501 05 001
   7501 05 002
   7501 05 003
   7501 05 004

4. Drain the fuel tank.

5. Clean the filter screen, as you learned in module 7501 04 001.

6. Remove the air housing.

7. Remove the flywheel, as you learned in module 7501 08 001.

8. Clean the magneto area.

9. Check the magneto.

JOB STEPS

10. Replace the points and condenser. Then, set the points to the proper gap (see module 7501 08 002).

11. Adjust the timing as you learned in module 7501 14 001.

12. Using a torque wrench, install the flywheel. Be sure to torque the flywheel. You will have to find the proper torque specification in the service manual.

13. Take out the spark plug.

14. Using a compression gauge, check the compression. See the service manual for compression specifications.

15. Using a torque wrench, torque the head bolts, as shown in module 7501 01 003.

16. Put in a new spark plug.

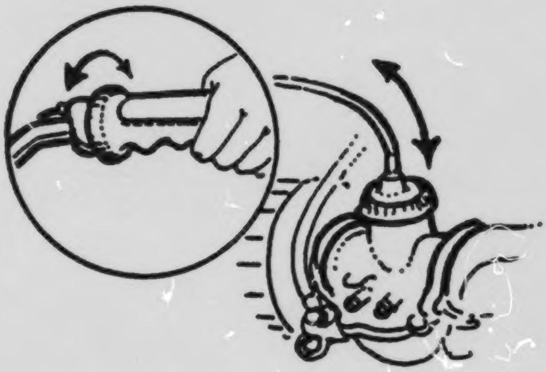
17. Install the carburetor, as you learned in module 7501 05 005.

18. Install the air housing.

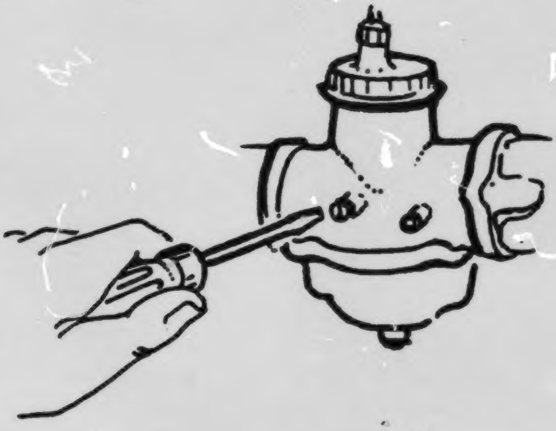
19. Put the snowmobile on the dynamometer.

JOB STEPS

20. Check the throttle cable. Be sure that the throttle shaft returns to the idle position against the idle stop-screw.



21. Start the engine. Adjust the idle and high speed jets. See module 7501 05 007.



22. Clean the snowmobile.

JOB STEPS

23. Be sure the track does not turn when the engine is idling.

24. Ask your instructor to check your work.

small engine repair

unit: Short Blocks

capital area career center

module: 7501 19 001 date: 7/77 level: IV

skill title: Install a Short Block in a Two Cycle Engine

developed & written by: Jim Pitts

visuals by: 200

WORD GUIDE

INSTALL - Put in.

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to remove and to install a short block in a two-cycle engine.

IN ORDER TO DO THIS YOU WILL NEED:

An engine without a short block

Hand Tools

Service Manual

Safety Glasses

WE WILL KNOW YOU CAN DO IT WHEN:

You have removed and installed a short block in a two-cycle engine, according to service specifications.

INFORMATION

For this job, you should refer to several mods you have already done. If you cannot remember what is in these mods, read them over again. These mods are:

7501 15 001	Remove and Replace Engine
7501 05 000	Carburetor Unit
7501 08 000	Magneto System
7501 18 000	Tune Ups
7501 03 001	Remove and Replace Starter

A new short block comes with crankshaft, rods, pistons, valves, and the internal engine parts. The carburetor, muffler, starter, magneto and other parts attached to the outside of the engine must be taken off the old block and put onto the new one.

WORD GUIDE

DISASSEMBLE - Take apart.

JOB STEPS

1. Take all equipment and materials to your work area. Be sure to wear your safety glasses.

2. Remove the new shortblock from the box. Look at it closely. Does it look like it goes in your engine (or does it look like a two-cycle short block)?

3. If your engine is mounted, remove it from the mower or saw or tiller. Refer back to module 7501 15 001.

4. Now, compare the length of the crankshafts. Is the new one the same as the old crankshaft? Does it take the same shape and reed plate? If there is a difference, tell the instructor.

5. Remove the carburetor first. Disassemble it and put it into the cleaner. Refer to a carburetor module from Unit 5.

6. Check the reed plate. Does it seal properly? If not, replace it.

7. Remove the air housing and flywheel. Then, check the coil and condenser and inspect the points.

8. Remove muffler if it was not removed along with the engine.

9. Remove anything that is not on the new short block that will have to be put onto it.

JOB STEPS

THINK SAFETY, WORK SAFELY!!

10. Now, clean all of the parts that will be put on the new short block.

11. Install the new points and condenser.

12. It is usually best to install the magneto first and time it, if needed.

13. Remove the carburetor from the carburetor cleaner and blow out with compressed air.

14. Using the new carburetor kit, rebuild carburetor.

15. If there is a reed plate on this engine, see if it has to be bolted to the carburetor or first if it can be bolted to the block.

16. After installing the carburetor and hooking up the governor, you should adjust the governor, if needed.

17. Now, you can install the air housing and starter assembly.

18. Install the muffler. Check to see if the muffler has to go on before or after the deck is installed.

19. Bolt the engine on its mounts

20. If the engine is mounted on a deck, be sure the blade is on tight. Ask your instructor to check it before starting.

JOB STEPS

21. Be sure the gas tank is clean. Put fresh gas and oil mixture in the tank. Be sure to check what gas and oil mixture is used in the engine:

    1/2 pint to a gallon

    1/4 pint to a gallon

    1 quart to 5 gallons

22. Start and adjust. Let it run until it uses all the gas.

23. Clean up unit for customer pick up.

24. Ask your instructor to check your work.

25. Put away all equipment.

small engine repair

unit: Short Blocks

capital area career center

module: 7501 19 002 date: 7/77 level: IV

skill title: Install a Short Block in a Four Cycle Engine

developed & written by: Jim Pitts

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to install a short block in a four-cycle engine.

IN ORDER TO DO THIS YOU WILL NEED:

Hand tools

Mods you have done before (see information page)

Service manual

WE WILL KNOW YOU CAN DO IT WHEN:

You have removed and installed a short block on a four-cycle engine according to service specifications.

WORD GUIDE

INSTALL - Put in.

INFORMATION

A new short block comes with rods, pistons, valves, and other internal engine parts. The carburetor, muffler, starter, magneto, and other parts attached to the outside of the block must be taken off the old block and put onto the new one. For this, you should refer to several mods you have already done. If you cannot remember what is in these mods, read them over again. These mods are:

7501 01 021	Crankshaft
7501 05 000	Carburetors
7501 15 000	Remove and Replace Engine
7501 01 003	R & R Head
7501 08 000	Magnetos
7501 03 001	R & R Starter

Some short blocks, made by Tecumseh, are called "crankless" short blocks. In these, the crankshaft is not installed but comes in the box with the short block. You will have to install and torque it yourself, before installing the short block.

JOB STEPS

1. Take all equipment and materials to your work area.

2. Remove the short block from the box. Is it a "crankless" short box? If so, go on to job step #3.

3. Check the short block. Do not write on this sheet. Use a separate sheet of paper.

    1. Is the crankshaft the same on the P. T. O end?

        yes __________ no __________

    2. Is the crankshaft the same on the flywheel end?

        yes __________ no __________

    NOTE: Some crankshafts in Briggs and Stratton engines have different length ends on the flywheel end of the crankshaft.

    3. Is the exhaust hole coming out of the same place as the old one (side or bottom)?

        yes __________ no __________

    4. Is the exhause valve in the same location (top or bottom)?

        yes __________ no __________

    NOTE: Some Tecumseh engines have the exhause hole in the bottom valve hole and some have them in the top valve hole. Be sure that the valve set up is the same on the two blocks.

    5. Is the oil fill hole in the same position on both blocks?

        yes __________ no __________

    6. Are the head bolts the same pattern?

        yes __________ no __________

    7. After you have completely checked the block and are satisfied it is the same, go on to step 4.

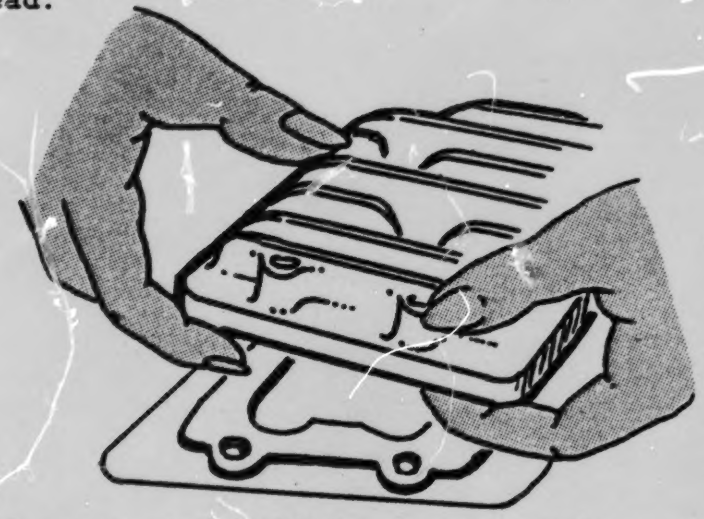
4. If you have a Tecumseh "crankless" short block, install the crankshaft into the block (as in mod 7501 01 021). Then do job step #5.

5. Remove the carburetor and manifold from the old block. Disassemble the carburetor and put it into the carburetor cleaner. Use module from unit 5.

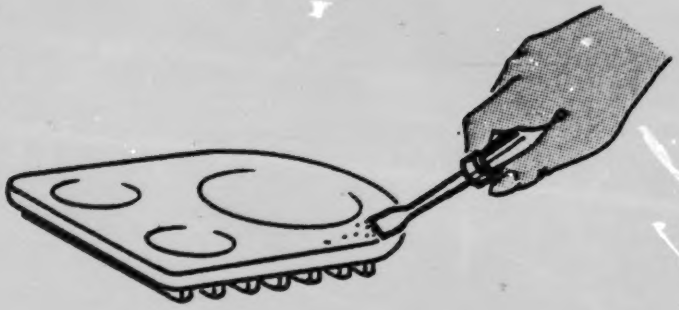
JOB STEPS

6. Remove the engine from its mount (if mounted). Refer to unit 15 mods.

7. Remove the air housing and flywheel and magneto assembly and also the head.



8. Clean up all parts that will be re-used. Clean carbon from head.

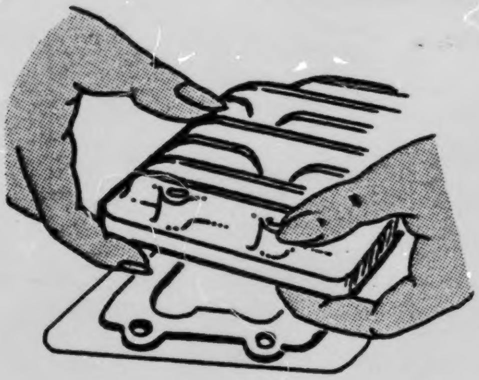


9. If the short block is a Briggs and Stratton model, it is all right to install the head at this time. Use mod 7501 01 003.

   NOTE: If it is a Tecumseh model, you will have to install and time the magneto **before** installing the head.

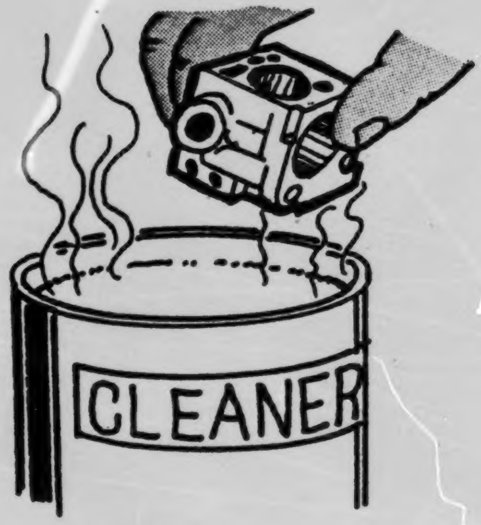
JOB STEPS

10. If you are installing a Tecumseh short block, begin by installing the magneto.



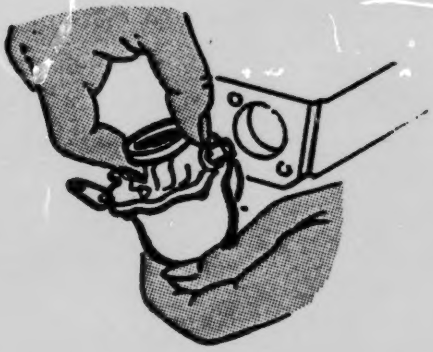
11. If you are installing a Briggs & Stratton short block, put in new points and condenser. Refer to unit 8.

12. Remove the carburetor from the cleaner and rebuild. Refer to unit 5.

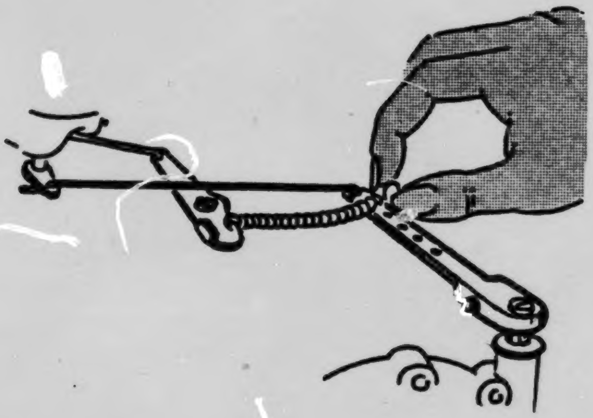


JOB STEPS

13. Install the manifold and carburetor.



14. Adjust the governor, if needed (This step usually applies only to mechanical governors). But be sure air vane type governors are working freely. Refer to mod 7501 05 006.



15. Install air housing and starter. Refer to mod 7501 03 001.

16. Fill the engine with the proper oil (for summer or winter) depending upon when the engine will be used.

17. Before turning on the gas to the carburetor, see if the gas tank is clean. If it is dirty, remove it, clean it, and put fresh gas in the tank.

18. Start, adjust, and check the engine for proper governor settings. Refer to mod 7501 05 006.

19. Stop the engine and clean it up for customer pick-up.

20. Now, ask your instructor to check your work.

small engine repair

unit: Storage

capital area career center

module: 7501 21 001 **date:** 12/77 **level:** I

skill title: Preparing a Mower for Winter Storage

developed & written by: Don Foster

visuals by:

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

Why and how you prepare a lawnmower for storage.

IN ORDER TO DO THIS YOU WILL NEED:

A set of tools
A lawnmower that will run
A can of oil
Safety glasses

WE WILL KNOW YOU CAN DO IT WHEN:

You have drained the gas from tank and lines, oiled the piston head as described in the job steps, and made sure the exhaust valve is closed.

INFORMATION

Why do you have to prepare an engine for storage? Because gas can turn to varnish if left in a carburetor over two to three months. The varnish can plug up holes in the carburetor so that the engine will not run. Also, if the engine is left with the exhaust valve open, it could possibly rust in the open position, and you would have to do a valve job.

JOB STEPS

Wear your safety glasses.

1. Drain the fuel from the gas tank:

   A. If you can, remove the gas tank and empty into a safe container. Then replace tank.

   OR

   B. Take off fuel line and drain tank into a safe container.

   OR

   C. Siphon out gas into a safe container.

2. Start the engine and allow it to run itself dry.

3. Put it on choke and keep trying to start it until it will not start any more.

4. Remove the spark plug and squirt oil in the spark plug hole (about a tablespoon of oil).

5. If the engine is equipped with a rewind starter or a rope pulley, spin the engine over to spread the oil evenly on the piston and valves (if your engine has an electric start or wind-up starter, go to step 8, skip steps 6 and 7.

6. Install the spark plug back into the engine.

7. Now you should rotate the engine until it comes up on the compression stroke (as you rotate the engine, you will feel a tight spot in the engine that is compression). Leave the engine on the compression stroke.

FOR ELECTRIC START MOWERS OR WIND-UP START MOWERS: Because you can't feel compression with these starters, you must use a "finger" method.

8. MAKE SURE STARTER IS NOT WOUND UP, then put a finger over the spark plug hole.

9. Reach under mower. BE CAREFUL: BLADES MAY BE SHARP. Turn blade until you feel compression on finger over spark plug hole.

10. Put spark plug back in. Do not connect spark plug wire.

11. Show your instructor what you have done.

small engine repair

unit: Storage

capital area career center

module: 7501 21 002 date: 2/77 level: I

skill title: Preparing a Chainsaw for Storage

developed & written by: Don Foster

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

You Are Going To Learn:

How and why you prepare a chainsaw for storage.

And In Order To Do This You Will Need:

Set of tools

Chainsaw in running order

Can of oil

We Will Know You Can Do It When:

The saw you have prepared is ready for storage and you are able to correctly answer your instructor's questions on this module.

INFORMATION

You need this information because:

Why do you have to prepare a chainsaw for storage?

Because gas will turn to varnish if left in a carburetor one to three months. The varnish can plug up holes in the carburetor, and the engine will not run properly. Also, the chain may rust up if it is not lubricated.

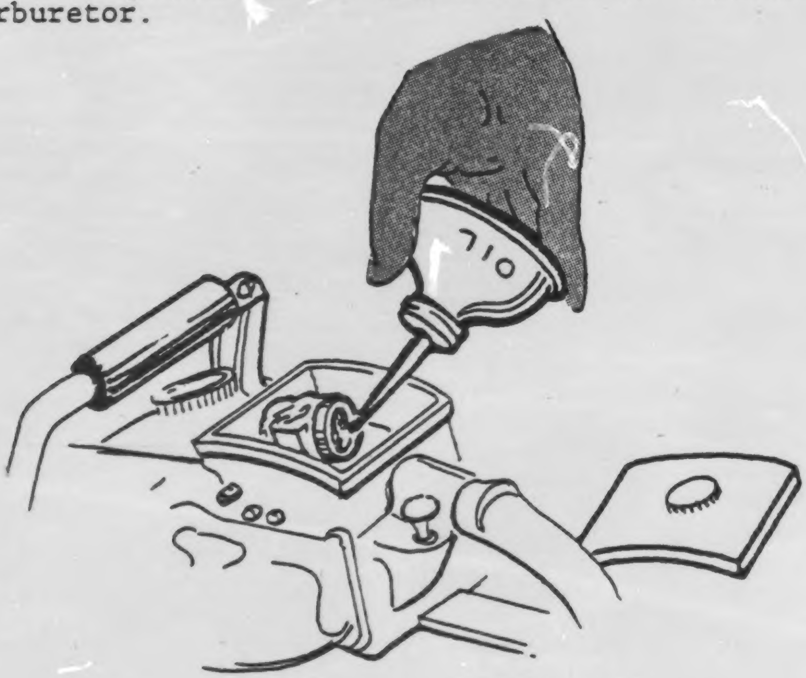
And the compression release, (if the saw has one) could allow moisture into the cylinder if it is left open.

WORD GUIDE

GUIDE BAR - The bar that the chain runs in on a chainsaw.

JOB STEPS

1. Remove the gas cap and dump the gas out of the gas tank.
2. Remove the air filter.
3. Clamp the guide bar in a vise being careful that the chain doesn't touch any part of the vise.
4. Start the engine and allow it to run until it quits.
5. Keep restarting the engine until it won't start anymore.
6. When you are sure all of the gas is out of the gas line and carburetor, squirt a small amount of oil in the throat of the carburetor.

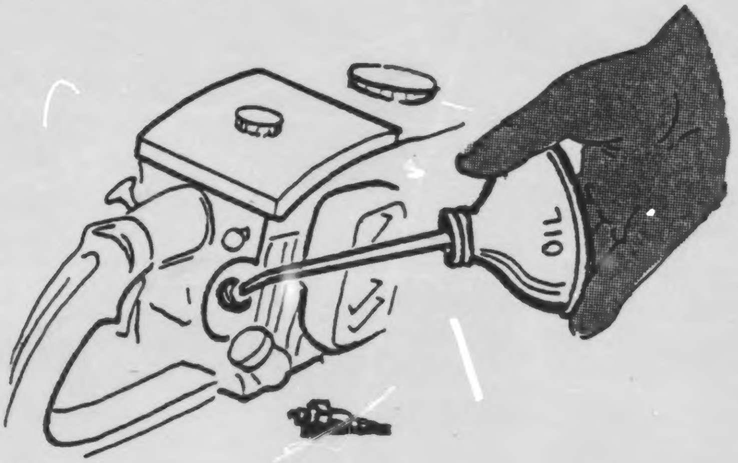


WORD GUIDE

COMPRESSION RELEASE - A devise, usually springloaded, that is used to leak compression when starting a chainsaw and after it starts, the release is locked out so that you have full compression when the engine is running.

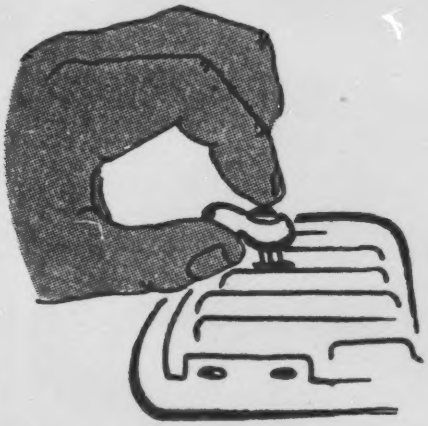
JOB STEPS

7. Remove the spark plug and squirt a small amount of oil into the spark plug hole. Turn the engine over with the starter to spread the oil.



8. Install the spark plug back in the cylinder. Pull the starter handle until the engine is on the compression stroke.

9. If the saw has a compression release, be sure that it is in the closed position.



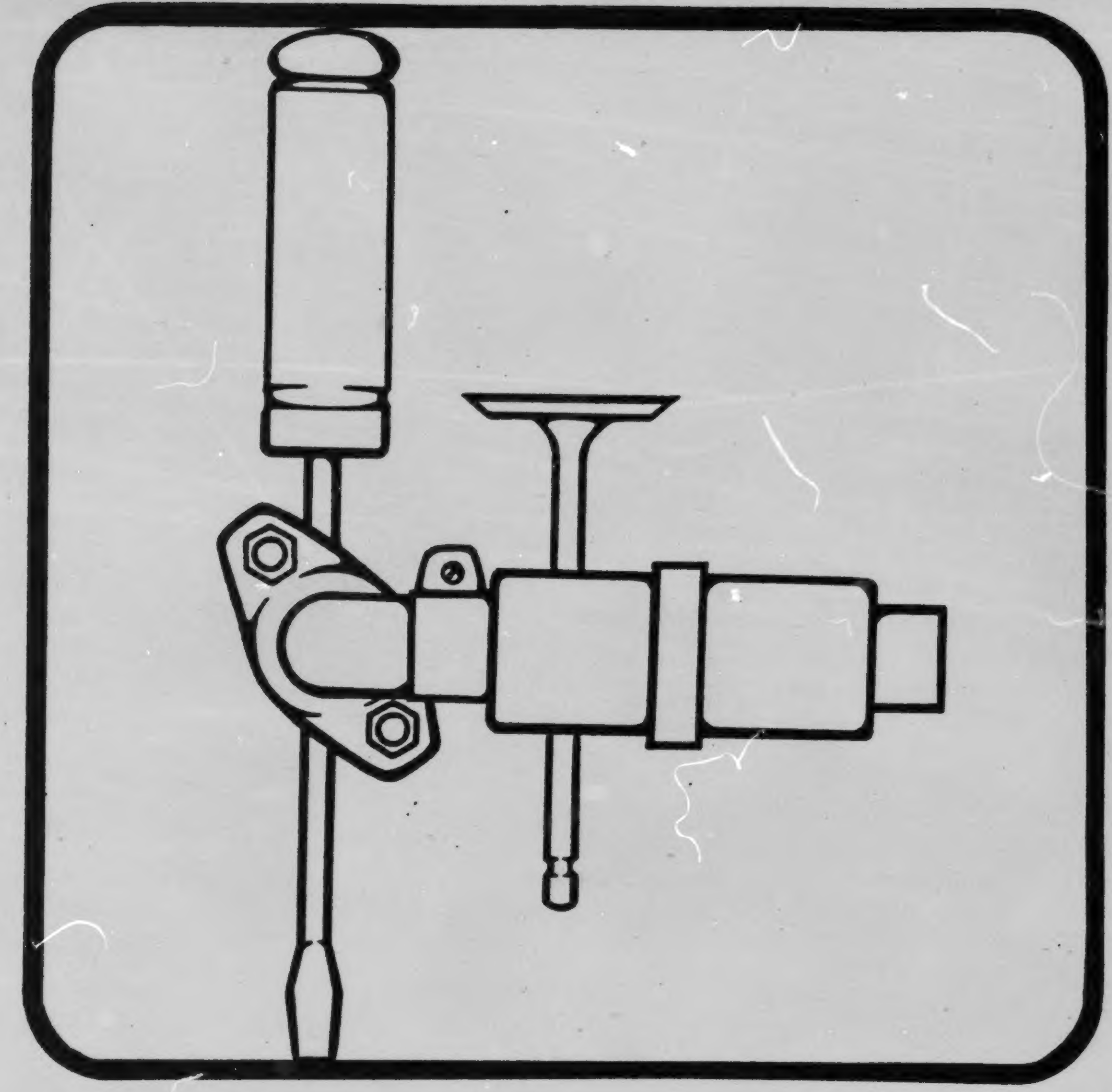
WORD GUIDE

BAR PROTECTOR - Put over a bar and chain on a chainsaw to protect people from getting cut if they accidently bump it while the saw is running.

JOB STEPS

10. Oil the chain and if the saw has a bar protector, be sure to put it on now.

11. Put away all equipment.



small engine repair

unit: STORAGE

capital area career center

module: 7501 21 003 date: December 1977 level: I

skill title: Preparing a Snowmobile for Storage

developed & written by: Don Foster

visuals by: Steve Bramer

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PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

Why, and how you prepare a snowmobile for storage.

IN ORDER TO DO THIS YOU WILL NEED:

A set of tools
A snowmobile in running condition
A can of oil
Safety glasses

WE WILL KNOW YOU CAN DO IT WHEN:

You have drained the gas from tank and lines, oiled the piston head, and have raised the track off the ground according to the job steps.

INFORMATION

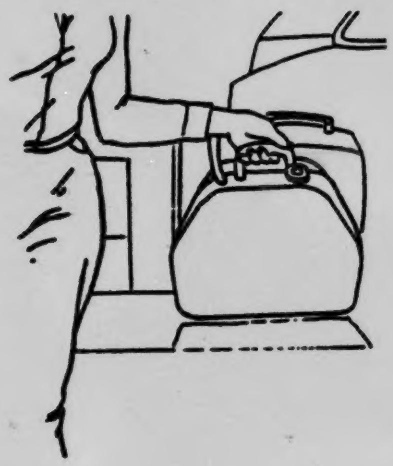
Why do you have to prepare a snowmobile for storage? Because gas will turn to varnish if left in a carburetor from one to three months. The varnish can plug up holes in the carburetor, and the engine will not run properly.

It is best to store snowmobiles inside. If the snowmobile is stored outside and just covered up, the machine should be raised up so that the track isn't touching the ground.

JOB STEPS

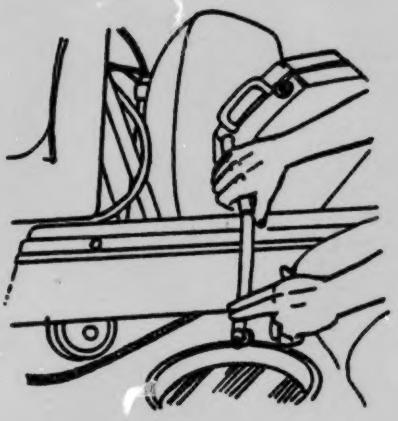
1. Remove gas from gas tank. Wear your safety glasses.

   I. If tank is easy to remove, remove the tank and dump it out.



   II. Remove the gas line from the carburetor and lay it down lower than the bottom of tank, but be sure that the gas line is outside the snowmobile.

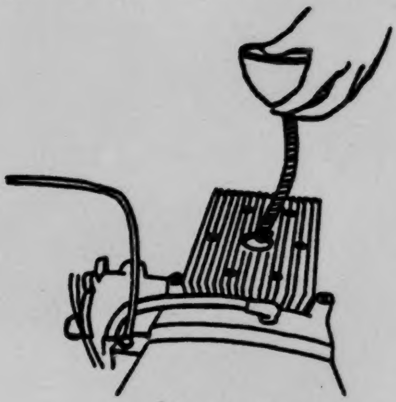
   III. Siphon it out of the gas tank.



2. Be sure the track isn't touching the floor then start the engine and let it run until it quits.

3. After it quits, try to restart it until it will not start any more.

4. Remove the spark plug and squirt oil into the cylinder.

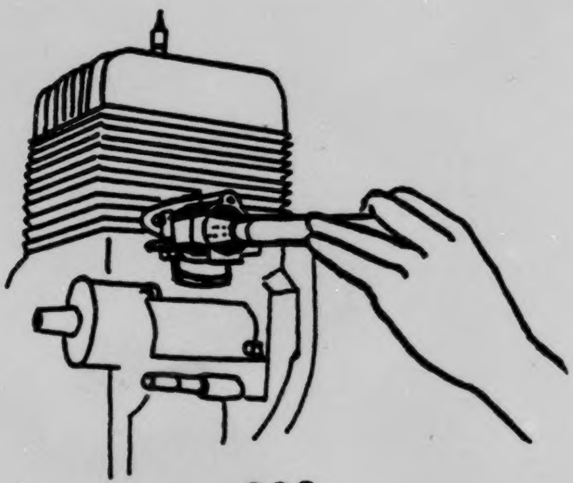


5. Crank the engine over four or five good cranks to spread the oil.

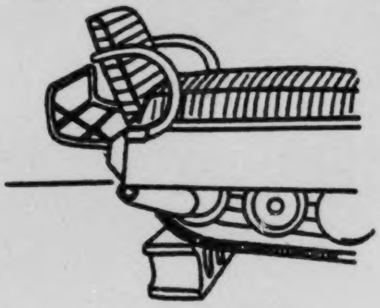
6. Install the spark plug.

7. Hold the throttle open and look in the carburetor and make sure the piston is covering the entire intake port.

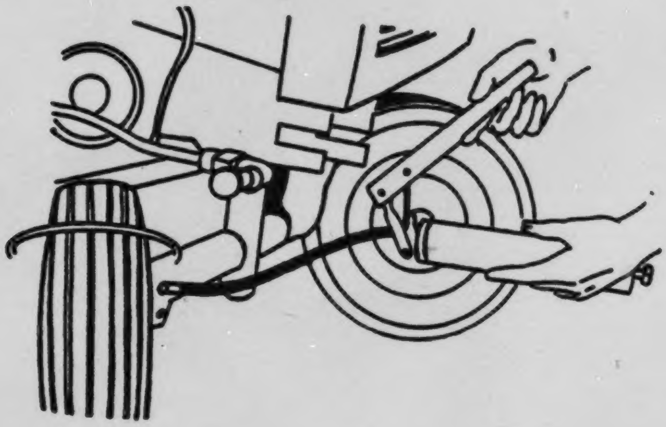
   NOTE: Do not put the engine on compression as you have on chainsaws and mowers. The reason for this is that the piston covering the intake port will seal the crankcase and also the upper part of the cylinder.



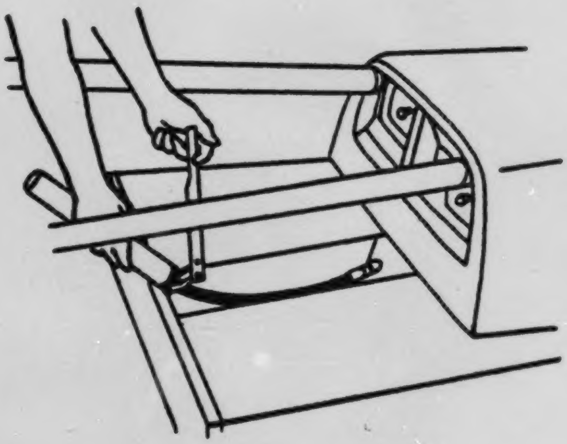
8. Be sure the rear of the snowmobile is raised so the track does not touch the ground or the floor.



9. Grease or oil the spindles.



10. Grease all fittings.



11. Show your instructor what you have done.

small engine repair

unit: FILLING OUT FORMS

capital area career center

module: 7501 22 001 **date:** 8/77 **level:** I

skill title: Writing a Work Order Properly

developed & written by: Don Foster

visuals by:

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to properly fill out a work order.

AND IN ORDER TO DO THIS YOU WILL NEED:

Work order

An identification tag

Pencil

Mower, chainsaw, snowmobile, or an engine

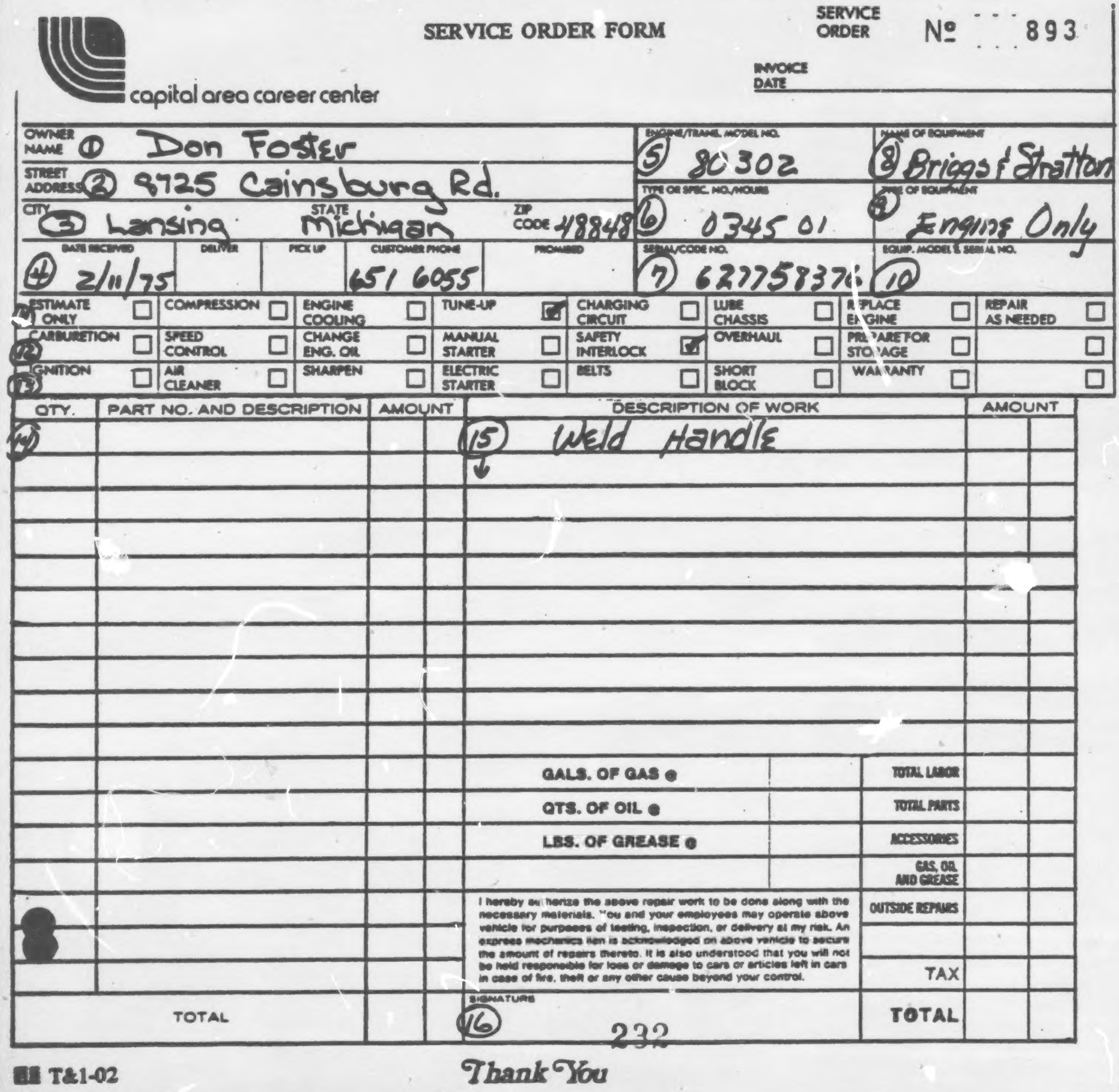
WE WILL KNOW YOU CAN DO IT WHEN:

You have filled out five different work orders for five different jobs or five different people, so that all jobs are described correctly and the information is accurate.

INFORMATION

An improperly written order may keep you from collecting the money that is due. If not written properly, your work order may give labor and parts away, or cause you to pay out money in a lawsuit.

Study the following work order form, then do the job steps.



capital area career center

SERVICE ORDER FORM

SERVICE ORDER № 893

INVOICE DATE

OWNER NAME ① Don Foster

STREET ADDRESS ② 9725 Cainsburg Rd.

CITY ③ Lansing STATE Michigan ZIP CODE 48848

DATE RECEIVED	DELIVER	PICK UP	CUSTOMER PHONE	PROMISED
④ 2/11/75			651 6055	

ENGINE/TRANS. MODEL NO. ⑤ 80302

TYPE OR SPEC. NO./HOURS ⑥ 0345 01

SERIAL/CODE NO. ⑦ 627758376

NAME OF EQUIPMENT ⑧ Briggs & Stratton

TYPE OF EQUIPMENT ⑨ Engine Only

EQUIP. MODEL & SERIAL NO. ⑩

⑪ ESTIMATE ONLY ☐	COMPRESSION ☐	ENGINE COOLING ☐	TUNE-UP ☑	CHARGING CIRCUIT ☐	LUBE CHASSIS ☐	REPLACE ENGINE ☐	REPAIR AS NEEDED ☐
⑫ CARBURETION ☐	SPEED CONTROL ☐	CHANGE ENG. OIL ☐	MANUAL STARTER ☐	SAFETY INTERLOCK ☑	OVERHAUL ☐	PREPARE FOR STORAGE ☐	☐
⑬ IGNITION ☐	AIR CLEANER ☐	SHARPEN ☐	ELECTRIC STARTER ☐	BELTS ☐	SHORT BLOCK ☐	WARRANTY ☐	☐

QTY.	PART NO. AND DESCRIPTION	AMOUNT	DESCRIPTION OF WORK	AMOUNT
⑭			⑮ Weld Handle ↓	
			GALS. OF GAS @	TOTAL LABOR
			QTS. OF OIL @	TOTAL PARTS
			LBS. OF GREASE @	ACCESSORIES
				GAS, OIL AND GREASE
				OUTSIDE REPAIRS
				TAX
TOTAL			SIGNATURE ⑯	TOTAL

I hereby authorize the above repair work to be done along with the necessary materials. You and your employees may operate above vehicle for purposes of testing, inspection, or delivery at my risk. An express mechanics lien is acknowledged on above vehicle to secure the amount of repairs thereto. It is also understood that you will not be held responsible for loss or damage to cars or articles left in cars in case of fire, theft or any other cause beyond your control.

T&1-02

Thank You

JOB STEPS

1. Get a sample sheet from your instructor.

2. Write the customer's name (use your own) in the left corner on line 1.

3. Write the street address (line 2).

4. On the next line, complete the address with the city, state and zip code (use your city, state, and zip code) (line 3).

5. Fill in line 4, "Date Received", using today's date. Leave "Deliver" blank and "Pickup" blank.

6. Fill in "Customer Phone" using your phone number. Leave "Promised" blank.

7. Go to the right of the work order and find line 5. This would be the model number of the engine you are working on. Choose an engine from your lab and write in the model number.

8. On line 6, write the type number of the engine you are working on.

9. On line 7, write the engine serial number.

10. On line 8, write the brand name of the equipment (mower, saw, etc.). If it is only an engine, put the name of the engine (Briggs, Clinton, Tecumseh, Roller, etc.).

11. On line 9, write the type of equipment such as tiller, chainsaw, outboard, etc. If it is an engine not mounted on anything, just write in the engine on line 6.

JOB STEPS

12. If it is equipment such as tiller, snowmobile, or outboard, then put the equipment model and serial numbers on line 10.

13. Lines 11, 12, and 13 are for different jobs to be done to the engine or equipment. All that you do now is put a check in the box of the job you want to do.

14. Pay no attention to line 14 in this. You will use this line in a different mod later.

15. Fill in lines 15, if the job is not one described in lines 11, 12, or 13.

16. Line 16 is for the customer to sign, and he/she must sign the order before any work can be done. Now sign your name.

    NOTE: If the order is not signed, the company, school or mechanic can not legally collect for any repairs. Also, if the customer wants to take the machine that you are holding for repairs, he can get it. BE SURE TO GET A SIGNATURE!

17. Show your completed work order form to your instructor.

18. If you did the sample form correctly, your instructor will give you some orders to write.

small engine repair

unit:

capital area career center

module: 7501 23 001 date: 4/77 level: I

skill title: How to remove and replace piston rings

developed & written by: Don Foster and Dwight Smith

visuals by: Dave Wehrwein

234-A

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to remove and replace piston rings, clean ring grooves and check ring land clearance.

AND IN ORDER TO DO THIS YOU WILL NEED:

A ring set

A piston and rod

A vise

WE WILL KNOW YOU CAN DO THIS WHEN:

You have:

A. Removed the old rings.

B. Cleaned all the carbon from the ring grooves.

C. Put the new rings on without breaking any.

D. Checked the ring land clearance and you can tell if the piston needs to be replaced.

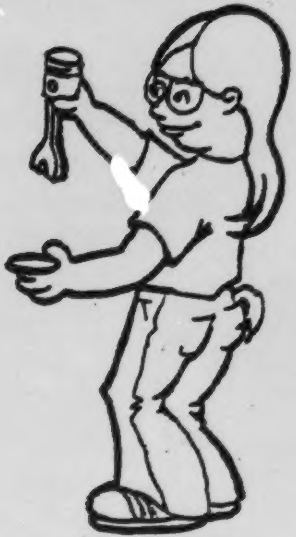
INFORMATION

Piston rings are made of very hard and brittle metal. They will break very easily, so handle them with care.

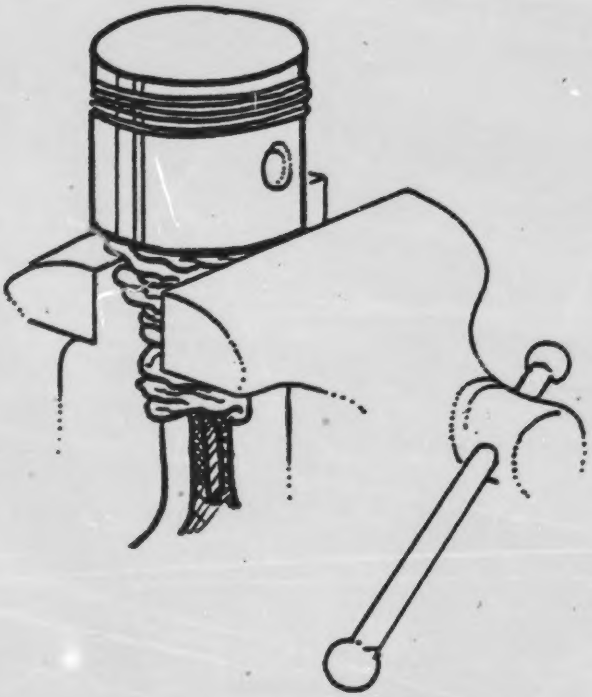
The rings seal the piston to the cylinder to allow the engine necessary compression. If there is carbon under the rings, the seal will be poor, the engine will wear out fast and burn oil. Be careful to clean the ring grooves when you replace rings.

JOB STEPS

1. Get the piston and ring set on which you'll work.

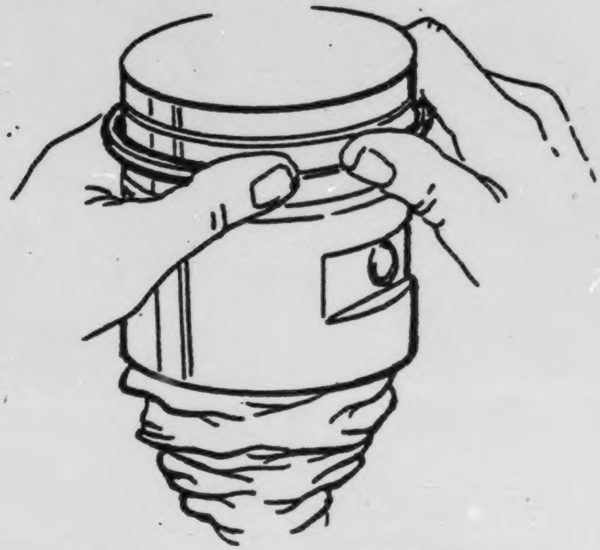


2. Put the connecting rod in the vise and tighten it lightly. Then, wrap the rod with a rag and clamp it with the piston facing up.



JOB STEPS

3. Using your fingers on the ring-ends spread open the top ring. At the same time, pull it up and then, when the ring is larger than the piston, lift the ring off the piston.



4. Repeat Job Step 3 for the second ring.

5. Using a ring groove cleaner, clean the ring grooves. If you do not have a ring groove cleaner, you can make one this way.

   A. Break an old ring in half.

   B. Grind one end flat and the other sharp.

   C. Scrape the carbon out of the ring grooves.

6. Spread the new rings like you did in Job Step 3 and slip them onto the piston.

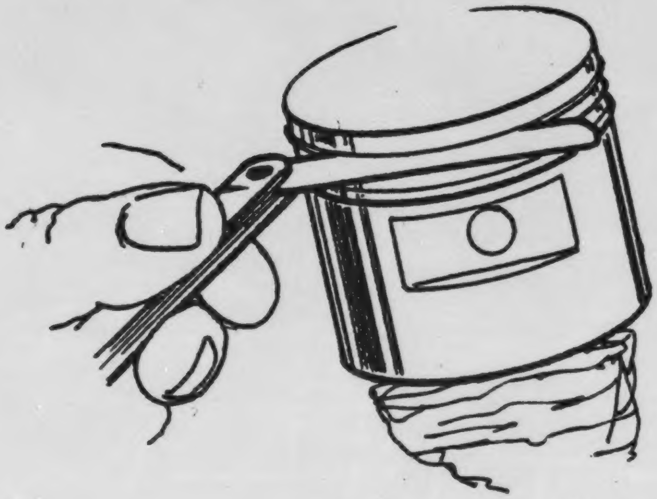
****
* *
* CAUTION - Be careful not to spread the ring *
* ends too far or the ring will break. *
****

JOB STEPS

7. Ask your instructor to check your work.

8. Before checking ring land clearances, read Repair Manual IV, Section 9, page 2.

9. Placing the proper feeler gauge between ring and ring land, check the ring land clearance. If the clearance is greater than what the manual calls for, you must replace the piston.



Now you know how to remove and put back piston rings and you can clean the ring grooves.

10. Put away all equipment.

small engine repair

unit: Engine Block

capital area career center

module: 7501 23 002 **date:** 2/77 **level:** I

skill title: How to Install Piston Rings on the Piston in the Correct Order

developed & written by: Don Foster

visuals by: Dave Wehrwein

240

WORD GUIDE

INSTALL - Put in.

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to install piston rings on the piston in correct order.

IN ORDER TO DO THIS YOU WILL NEED:

Ring display
Set of rings
A piston

WE WILL KNOW YOU CAN DO IT WHEN:

You have correctly installed piston rings on the piston in the right order.

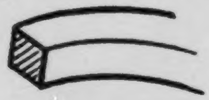
WORD GUIDE

GROOVE - Notch
GROOVELESS - Without any grooves.
BEVEL - Slanted surface.

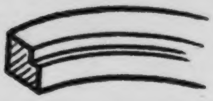
INFORMATION

Most pistons have three kinds of rings. A compression ring, an oil scraper ring, and an oil ring.

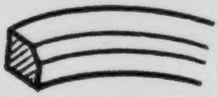
The compression ring goes into the top ring groove on the piston. There are different types of compression rings. Here are three common types:



Grooveless rings may be installed either side up.

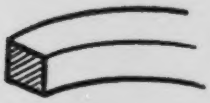


Compression rings with grooves must be installed with the groove toward the top of the piston.

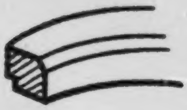


Compression rings with bevels must be installed with the bevel up, toward the top of the piston.

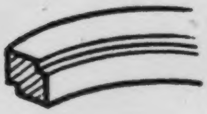
The second kind of ring, the oil scraper ring, is installed in the center ring groove on the piston. The oil scraper ring has a groove in the outside of the ring and must be installed with the groove down. Here are three common types:



Oil scraper ring (NOTE: Groove on outside of ring.) This ring must be installed with outside groove toward bottom of piston.



Oil scraper ring (NOTE: Groove on outside and bevel on inside.) Bevel goes up; groove goes down.



Oil scraper ring (NOTE: Groove on outside and groove inside.) Inside groove goes up; outside groove goes down.

The third kind of ring is the oil ring. This ring goes in the bottom ring groove on the piston. There is one common type:

Oil ring - Ring can be installed either way.

JOB STEPS

1. Take all equipment to your work area.
2. Get the ring display from A-frame display board.
3. Study the rings.
4. Look at the drawing of each ring on the INFORMATION page and compare drawings with the rings.
5. Separate the compression rings from the oil scraper rings, then show your instructor.
6. Ask the instructor for a set of rings and a piston.
7. Install the rings in the right order on the piston as you have learned. Make sure the rings are installed with the right side up on the piston.
8. Ask the instructor to check your work.

small engine repair

unit: Ring Service

capital area career center

module: 7501 23 003 date: 3/77 level: I

skill title: Deglaze Cylinders and Check End Gap

developed & written by: Don Foster

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to deglaze a cylinder on an engine and how to check the piston ring end gap.

IN ORDER TO DO THIS YOU WILL NEED:

A cylinder with the piston removed

B & S Repair Manual No. IV

Piston

Set of rings

Electric drill motor

Deglazing hone

Lubricant

WE WILL KNOW YOU CAN DO IT WHEN:

1. The cylinder you deglaze has no varnish or glaze left on it.
2. You can answer the questions about deglazing cylinders.
3. You have installed piston and rings.
4. You have measured the piston ring end gap.

WORD GUIDE

GLAZE - Smooth, shiny, surface.

CLEARANCE - Distance between ends of the ring.

MINIMUM - Lowest allowable amount.

EXPAND - Get larger.

INFORMATION

A cylinder that needs glazing will look shiny. Cylinders should be degalzed so that the glaze is broken. If a glaze remains on a cylinder wall, new piston rings will not seat properly.

If you are using chrome rings, you do not have to deglaze the cylinder. You also don't have to deglaze cylinders on an aluminum engine, but it will help the rings to seat if you do.

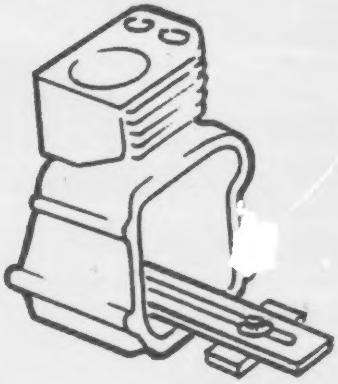
Some aluminum engines have steel sleeves in the cylinders. In order to tell if the engine has steel sleeves, clean off the top of the engine block. If there is a dark ring around each cylinder, there is a steel sleeve. If not, it is an aluminum cylinder.

To find out more about cylinders, read B & S Repair Manual IV, Section 9, pages 1-4, and Section 11, pages 1 and 2.

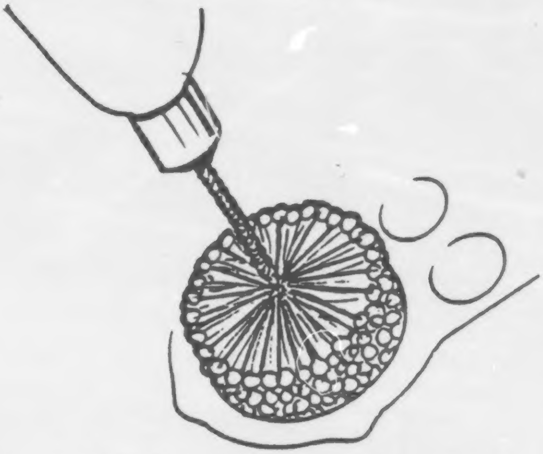
After you have read about cylinders in the B & S Manual, check the end gap in the engine to be sure you have enough minimum clearance between the ends of the rings. If there isn't enough the ends of the rings may butt together and break or cause the engine to stop.

JOB STEPS

1. Be sure you wear safety glasses during all these steps.
2. Take all equipment to your work area.
3. Clamp the block down to the bench. Be sure to clamp it where you won't crack the block.



4. Install the deglazing hone in the chuck of the 3/8" drill. Do not plug in.
5. Place the hone in the cylinder and move the hone up and down a couple of times. Check to see that the stones don't go out of the cylinder more than 1" at top or bottom.



6. Lubricate the cylinder. If the cylinder is aluminum, use a lard oil such as Mazola, Wesson, or Crisco oil. If there is a cast iron or steel sleeve, you can use oleum, kerosene, or a commercial honing oil.

JOB STEPS

7. Now, make sure the trigger isn't locked on the drill and then plug in the drill.

8. Using slow, up-and-down strokes, turn on the drill. Be careful that the hone does not go too far on the down stroke and be sure it does not come out too far on the out-stroke.

   REMINDER: Work Safely!!!!!

9. Check the cylinder often, until most of the glaze is gone. Remember to shut off the drill before removing the hone from the cylinder.

10. When most of the glaze is gone, clean the block and cylinder with oleum or soap and water. CAUTION: Cylinder must be completely cleaned of grit.

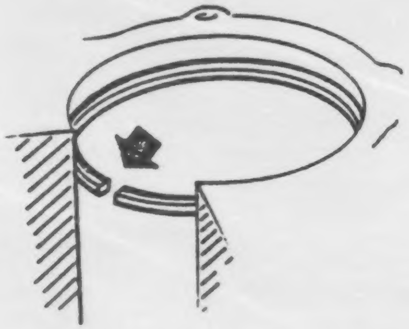
    NOTE: If you use soap and water to clean a cylinder after deglazing, you will have to dry it off. Oil the cylinder with a lot of 30w cylinder oil. This will prevent rust.

11. Show the cylinder to your instructor. He/she will ask you questions.

    NOTE: If you are not wearing your glasses when you take the cylinder to the instructor, you will have to do the Mod over.

12. Put rings into the cylinder. Then, push the rings down into the cylinder to the bottom of the ring travel.

13. Now, check the ring end gap. Look up information on ring gap in the manual. If there isn't a manual available, a good rule of the thumb would be to figure .003 minimum end-gap per inch of diameter of the ring sample. (2 inch ring = .006 gap, 2½" ring = .009, 3" ring = .009)



14. Show your instructor the end gap. If it is not OK, the instructor will help you.

small engine repair

unit: RINGS

capital area career center

module: 7501 23 004 date: 3/77 level: I

skill title: Using a Piston Ring Compressor and Spacing the Ring End Gaps

developed & written by: Don Foster

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to use a piston ring compressor and how to properly space the ring ends on the piston.

AND IN ORDER TO DO THIS YOU WILL NEED:

A piston with rings

A block

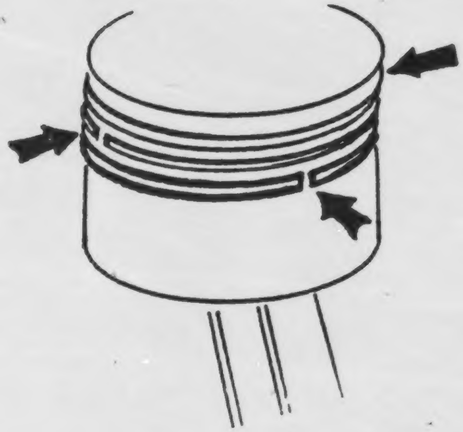
A ring compressor

WE WILL KNOW YOU CAN DO IT WHEN:

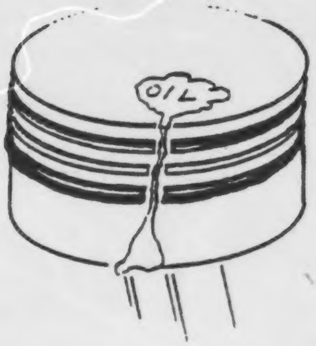
You have installed the piston and rings into the cylinder with the ring ends staggered.

INFORMATION

When you install the piston rings on the piston, you must be sure that the ring end gaps are staggered before you put the ring compressor on the piston.



If the ring end gaps are lined up, they will leak compression and the engine may not run or may burn a lot of oil.

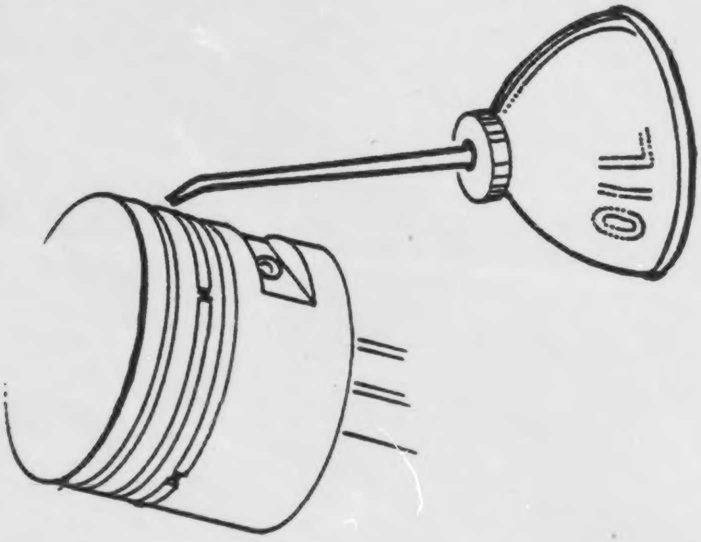


JOB STEPS

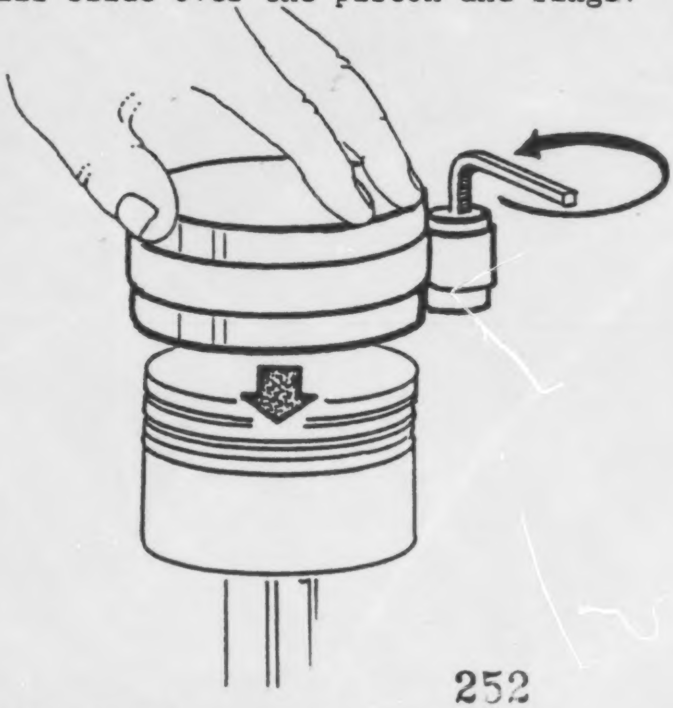
1. Get your equipment and go to the work area.

2. Put the rod and piston in a vise (clamp very lightly on the rod).

3. Now, stagger the ring end gaps and lightly coat the piston and rings with oil.



4. Using the ring compressor handle, open it up so that the compressor will slide over the piston and rings.

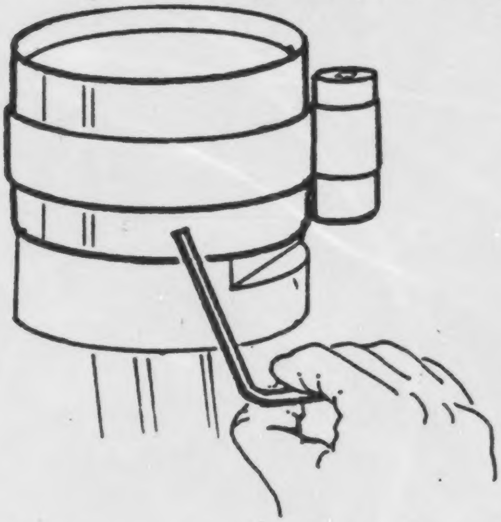


JOB STEPS

5. Leave the ring compressor up from the bottom of the piston about ½ inch.

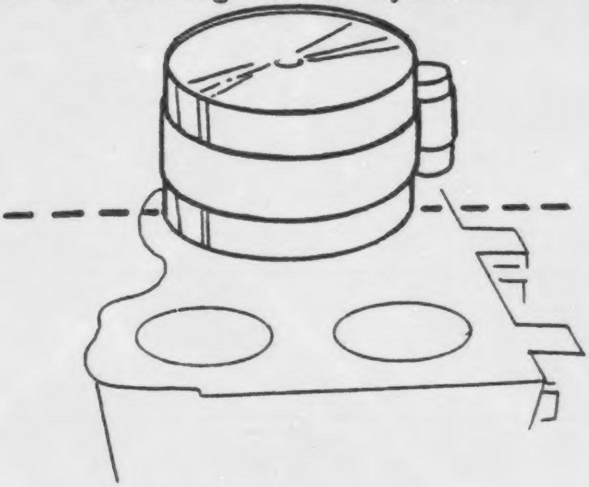
6. Tighten the compressor lightly.

7. Now, tap lightly on the side of the ring compressor. (This will seat the rings in the grooves.) Use the compressor handle with which to tap where the rings are in the grooves.



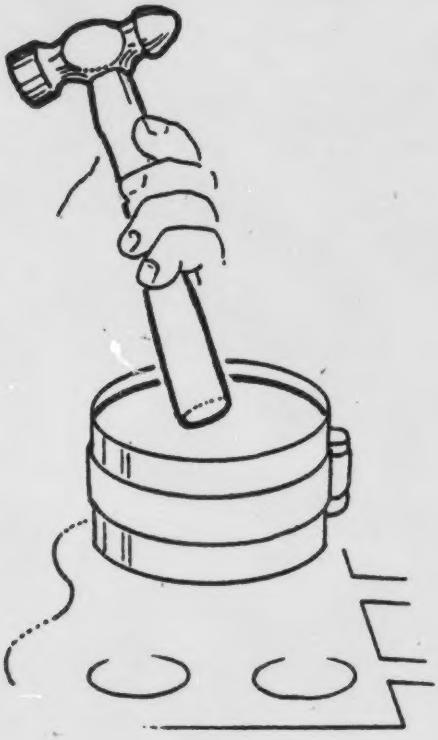
8. Remove the piston and rod from the vise.

9. Insert the piston and rod into the cylinder until the compressor is resting on the cylinder.



JOB STEPS

10. Now, using a wooden hammer handle, gently tap the piston down into the cylinder.



small engine repair

unit: Rings

capital area career center

module: 7501 23 005 date: 3/77 level: I

skill title: Checking Ring Land Clearance

developed & written by: Don Foster

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

You are going to learn:

How to check ring land clearance.

And in order to do this you will need:

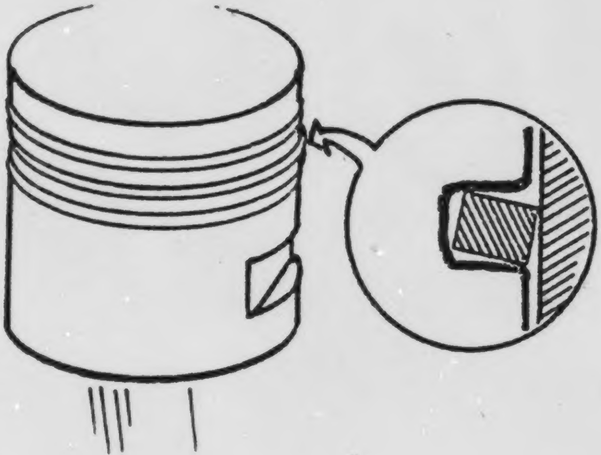
A piston with rings installed.

We will know you can do this when:

You have measured the ring land clearance and your measurements agree with those of the instructor.

INFORMATION

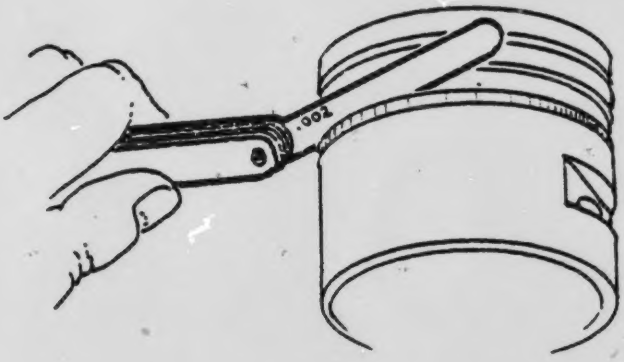
If the ring land clearance is too great, the rings could break because the ring might twist as it moves up and down.



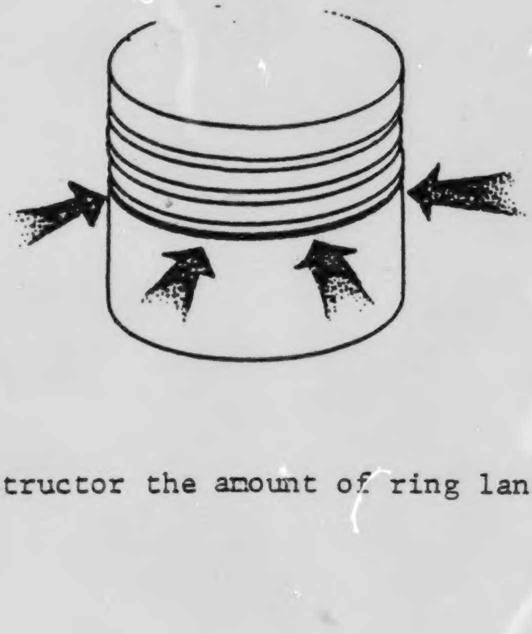
If the ring land clearance is too tight, this usually means that the piston has been dropped. That will cause the ring to bind into the groove and will keep the ring from expanding against the cylinder (causing a loss of compression).

JOB STEPS

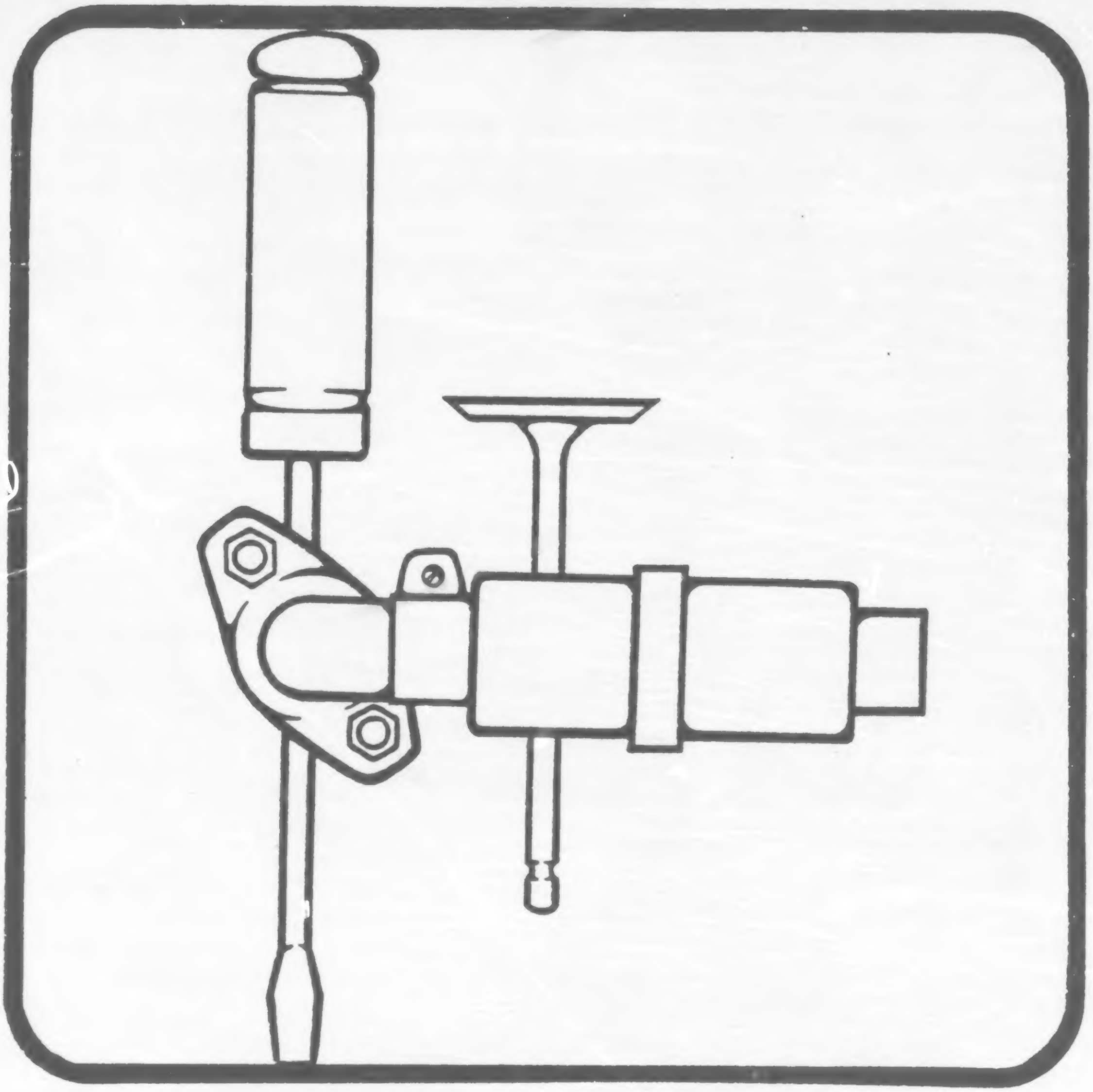
1. Get all equipment and go to your work area.
2. Get Briggs & Stratton repair manual No. 4 and read section 9, Page 2.
3. Try to put the .002 feeler gauge between the piston ring and the ring land.



4. Check the clearance all the way around the piston for tight spots.



5. Tell the instructor the amount of ring land clearance.



small engine repair

unit: RINGS AND PISTON SERVICE

capital area career center

module: 7501 23 010 date: April 1977 level: II

skill title: How to Service Pistons and Rings

developed & written by: Don Foster and Dwight Smith

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to service pistons and rings.

AND IN ORDER TO DO THIS YOU WILL NEED:

A 2 or 4 cycle engine

Socket set

Screwdriver set

Seal

Gasket kit

Lubriplate

Rubber mallet

Micrometer

Ring groove cleaner

Feeler gauge

Work bench

Piston ring compressor

WE WILL KNOW YOU CAN DO IT WHEN:

You have done a ring job on an engine, assembled the engine, according to manual specifications and can run the engine.

WORD GUIDE

CAM GROUND - A piston that is wider one way than the other.

INFORMATION

Why do you need to replace rings on engines?

When an engine starts to burn and lose oil, it is often because the rings are worn out. With new rings an old engine can run smoothly again.

Rings are parts of pistons. Not all pistons are perfectly round. Some are cam ground. This means they are wider at one end than at the other. The widest side is opposite the wrist pin holes.

NOTE: The reason a piston is cam ground is because a cam ground piston will fit more uniformly in the skirt when it gets hot and expands.

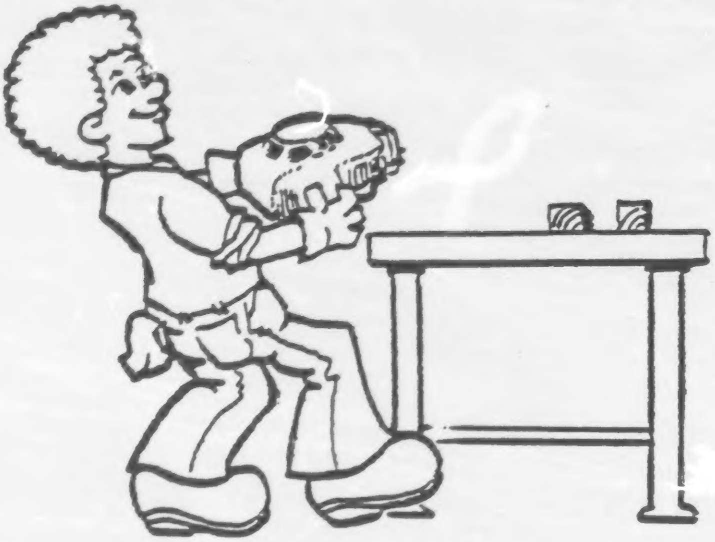
NOTE: The piston is usually smaller in diameter at the ring land area than at the skirt area.

Read page 3 of Mod 7501 23 002 to learn more about pistons and piston rings.

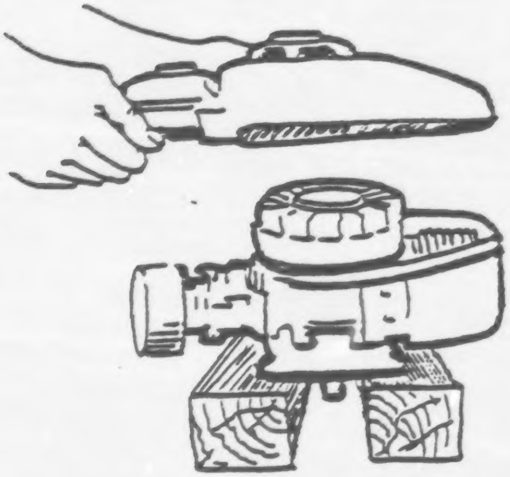
Also read Section 9 of the B & S Manual IV.

JOB STEPS

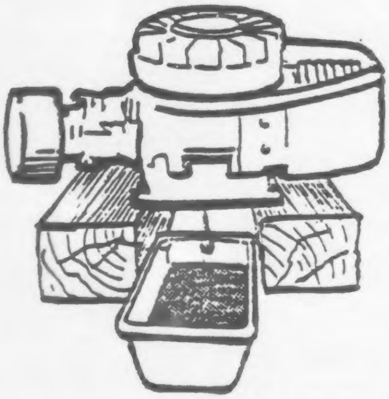
Get the engine on which you will work. Put it on the work bench.



2. Take the head and air-housing off the engine.

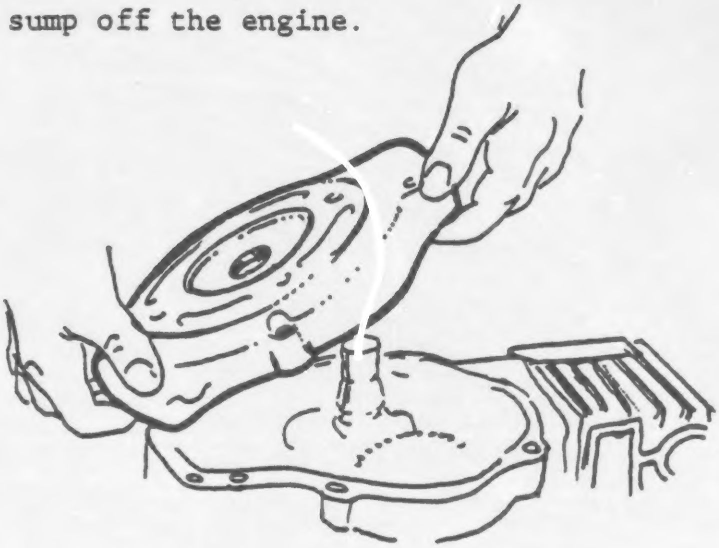


3. Drain the oil out of the crankcase.

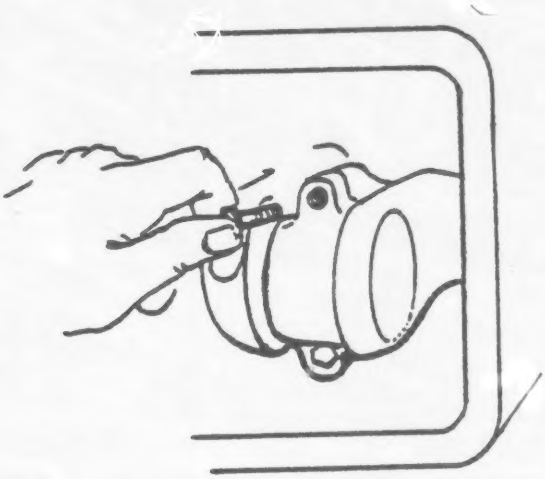


JOB STEPS

4. Take the sump off the engine.



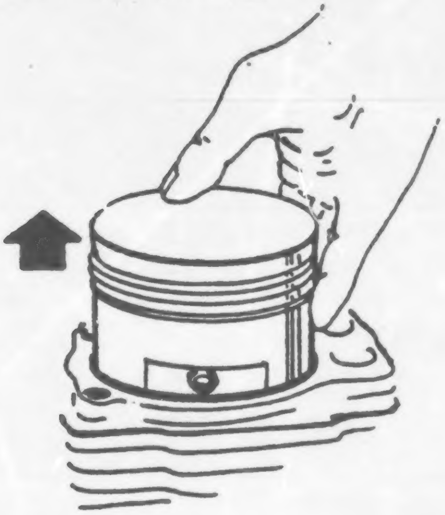
5. Take off the rod bolts or nuts.



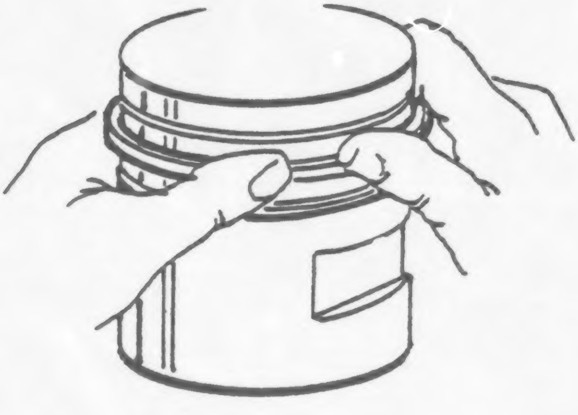
JOB STEPS

6. Look at the rod and crankshaft. Notice how the rod is attached to the crankshaft. Then, take the rod and piston out of the block.

   NOTE: The piston and rod must come out of the top of the cylinder. Push up with one hand and hold the piston with the other to avoid scratching the cylinder and piston.



7. Service the piston rings like you did in Mod 7501 23 001, (How To Remove and Replace Piston Rings). Be sure to remove the rings towards the top of the piston. Do not put the rings on yet.



WORD GUIDE

WEAR - Decay because of extra use.

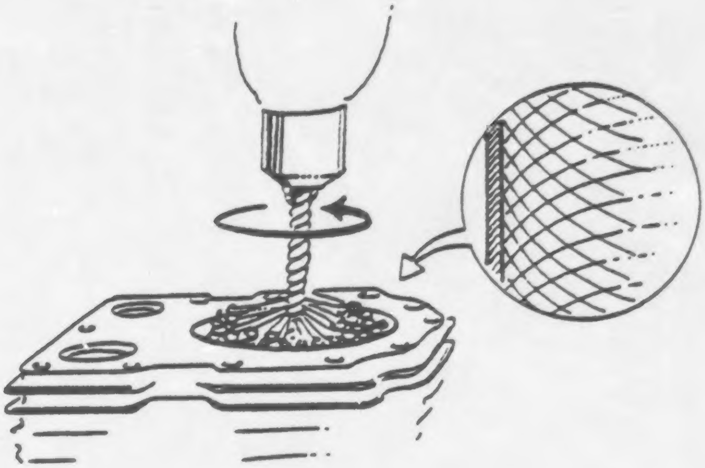
JOB STEPS

8. Check the cylinder for wear and damage. Look for scoring, (deep lines or grooves where there shouldn't be any) and other wear.

   NOTE: On chrome-plated cylinders, check for chrome peeling off the cylinders. On aluminum cylinders, check for galling, (galling looks like a weld on the piston, and like a rip in the cylinder).

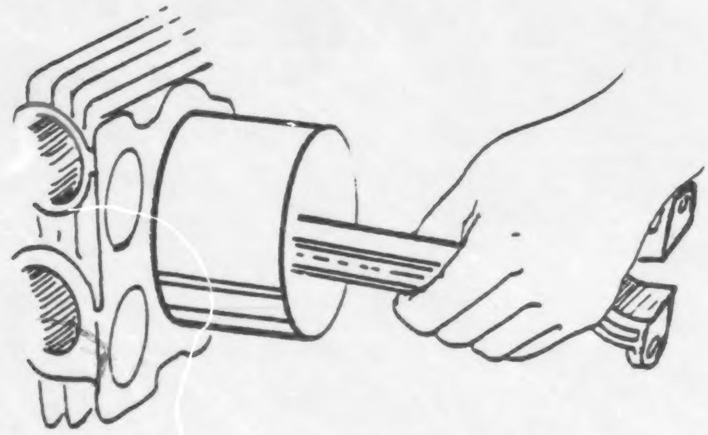
9. Read the B & S Manual for piston skirt clearances for this engine. Look at the picture of the piston in this mod.

10. Deglaze the cylinder. Refer to mod 7501 23 003.

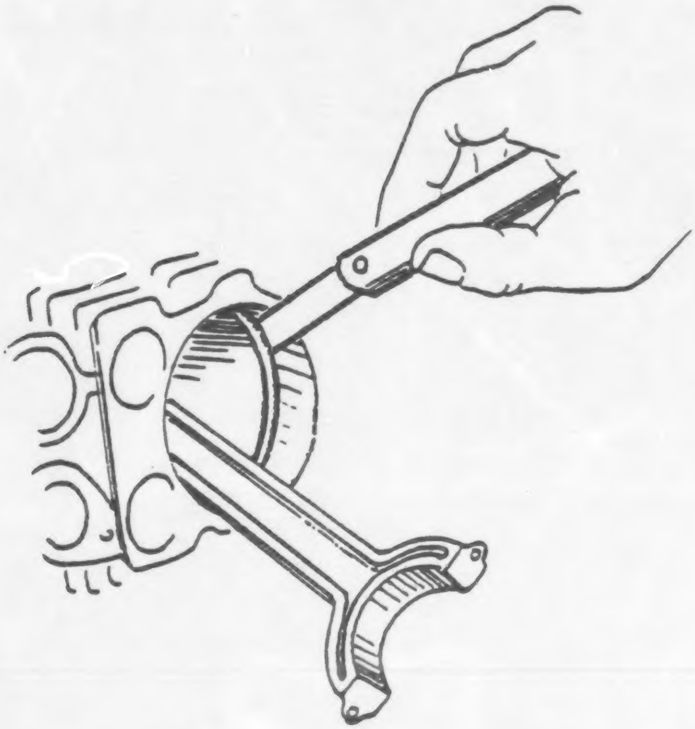


JOB STEPS

11. Hold onto the rod end and put the piston into the cylinder.

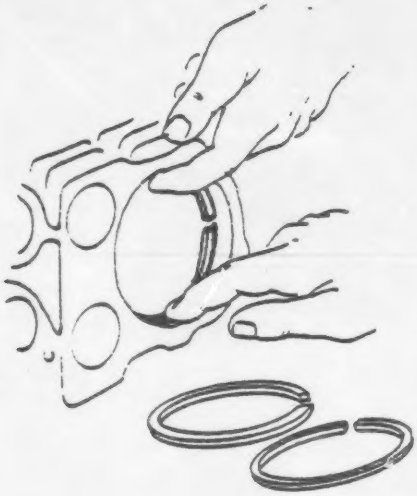


12. Using the proper feeler gauge, check the clearance on the side of the piston opposite the wrist pin holes.



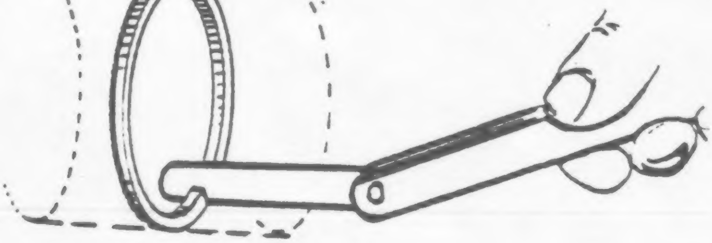
JOB STEPS

13. If the piston meets the specifications in the Manual, carefully put the rings into the cylinder.



14. Using the top of the piston, push the rings down to the bottom of the ring travel.

15. Check the ring end gap. Look up the gap in the Manual. If you do not have a Manual with this information, here is a rule of thumb: .003 minimum end gap per 1" of cylinder bore. With this, you can see that a 2" cylinder has a .006 ring end gap, a 2½" cylinder has a .009 ring end gap because you would round off to the nearest high decimal.

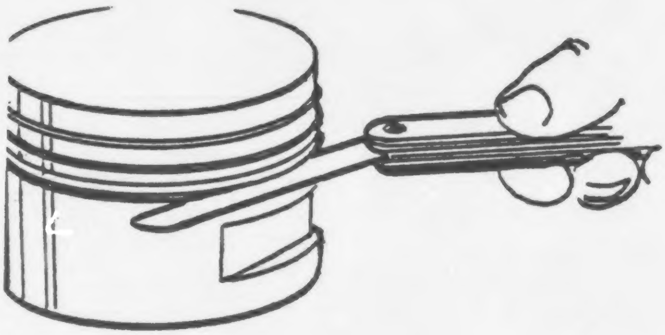


JOB STEPS

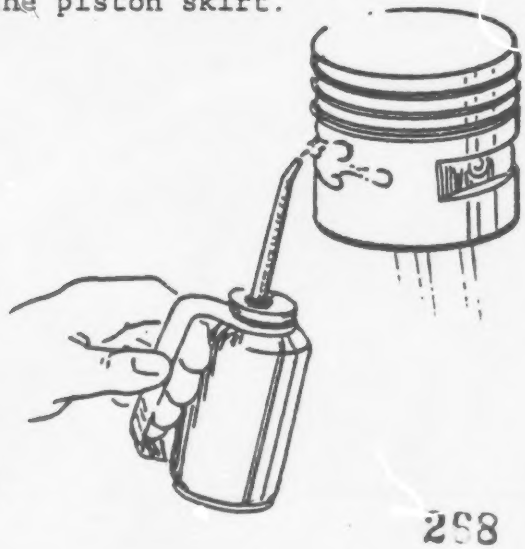
16. If the ring end gap is correct, pull the rings out of the cylinder.

17. Put the rings on the piston, like you did in Mod 7501 23 001. (Read Section 9, page 2 of Repair Manual IV.

18. Using a feeler gauge, check the piston ring land clearance. This is the distance between the ring and the ring land. Check the Manual or your instructor for the minimum and maximum clearances.

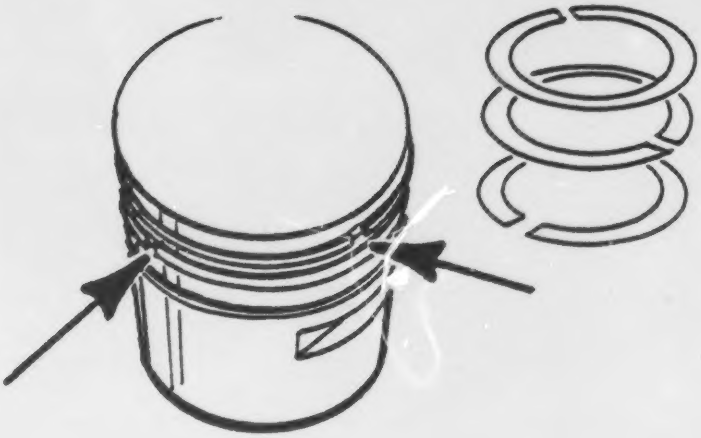


19. If the piston is OK, put a light coat of motor oil on the rings and the piston skirt.

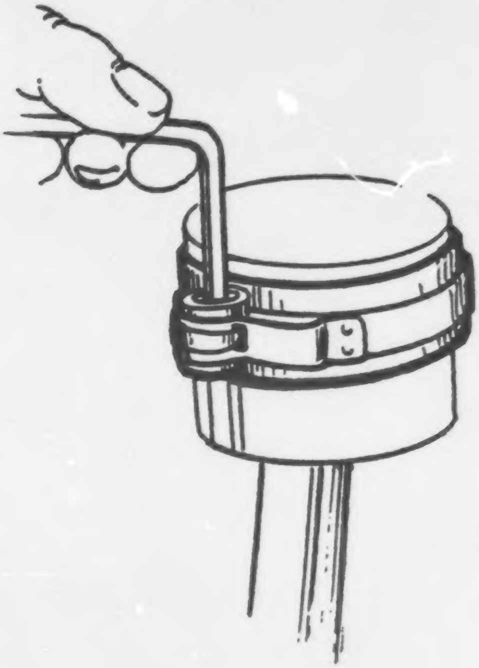


JOB STEPS

20. Check to see that the ring gaps are on different sides of the piston.



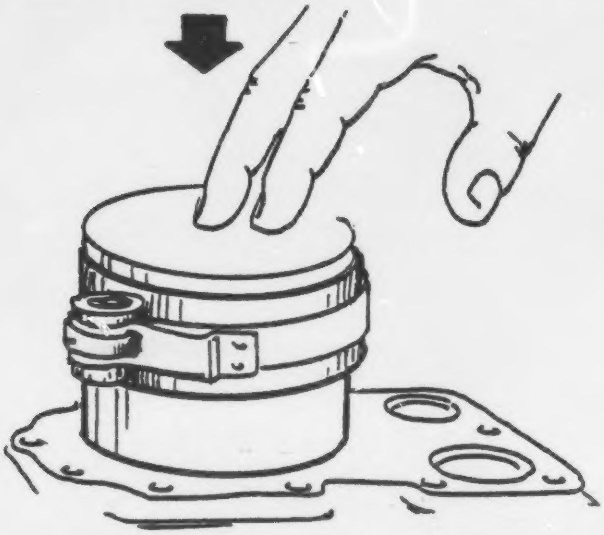
21. Put the piston ring compressor on the piston. The rod must be pointed down. Refer to Manual IV, pages 3 and 4 of Section 9.



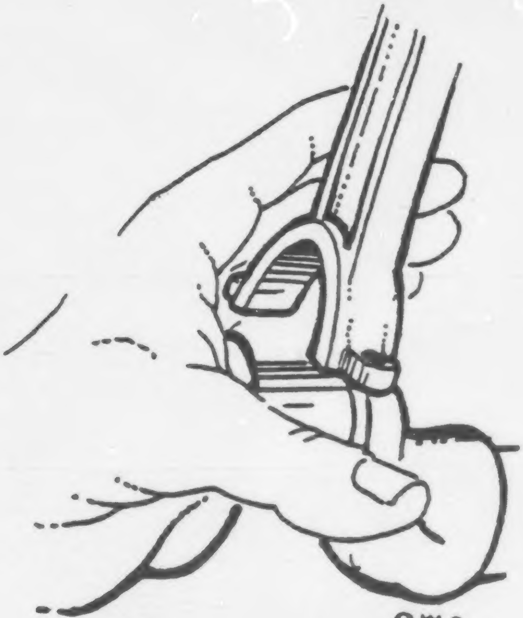
JOB STEPS

22. Put the piston and rod into the cylinder. Be sure to have the rod facing the right way.

23. Gently push the piston and rod down into the cylinder. Be careful not to scratch the cylinder walls.

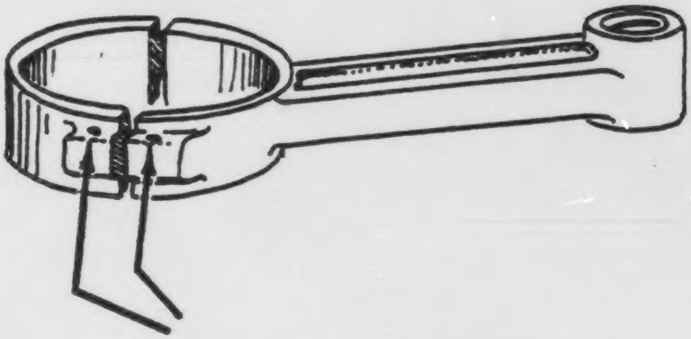


24. Guide the rod onto the crankshaft throw.



JOB STEPS

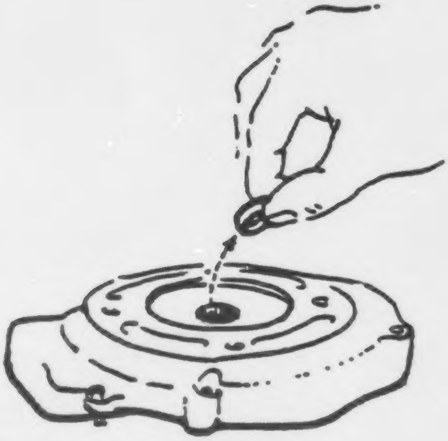
25. Match up the marks on the rod cap. If there is an oil splasher, be sure to put it on before the bolts or nuts.



26. Torque the bolts or nuts to specifications. (See the Manual) Bend the rod lock to the bolt head or nut.

27. If you took the camshaft out, put it back in. Be sure to align the timing marks, install the lifters, and retime the cam to the crank.

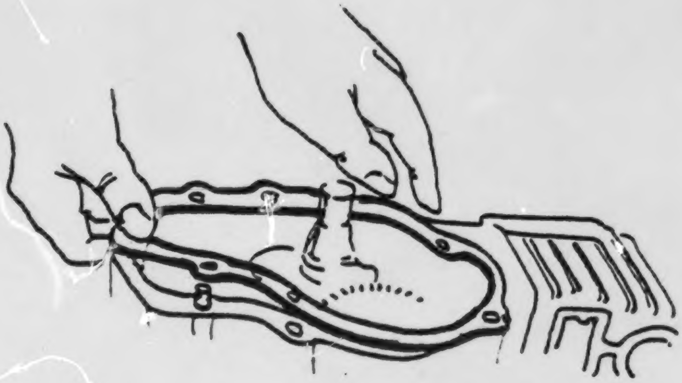
28. Remove the crankshaft seal from the engine sump.



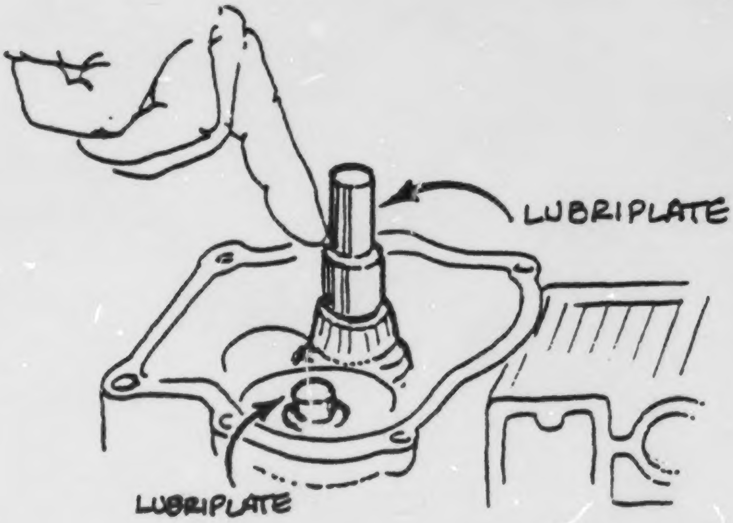
JOB STEPS

29. Clean the sump. Get it very clean for assembly.

30. Put the new gasket on the block. If the gasket is wrinkled, soak it in warm water for a minute or so. Be sure the dowel pins are in the right place to hold the gasket.



31. Put lubriplate on the camshaft and crankshaft bearing-surfaces.



32. If the engine has an oil slinger or a governor put it on.

JOB STEPS

33. Put the sump on the crankshaft. Align the camshaft with the bearing hole. Do not force the sump down.

    NOTE: If the engine has a mechanical governor, be sure the nylon governor gear is meshed with the cam gear. If not, turn the crankshaft back and forth.

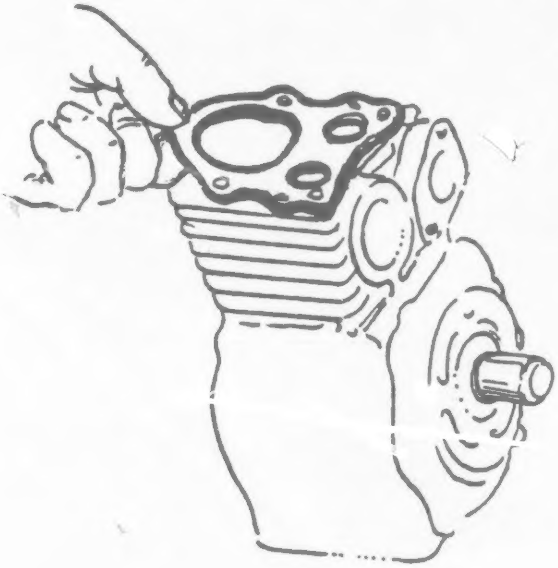
34. Gently push the sump the rest of the way down.

35. Put the sump bolts in. Torque them to the setting in the Manual. Usually 65 inch lbs. torque.

36. Check crankshaft end play.

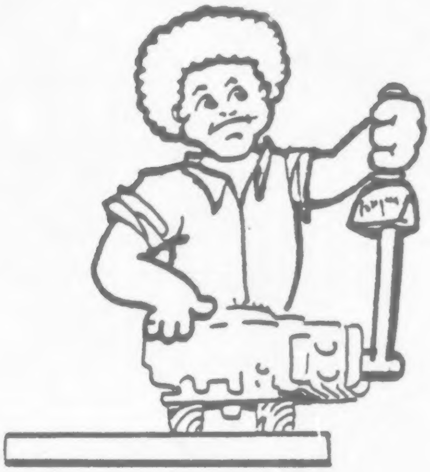
37. Put a new oil seal into the sump. Refer to Mod 7511 01 001.

38. Put a new head gasket on the engine. Be sure to put it on correctly.

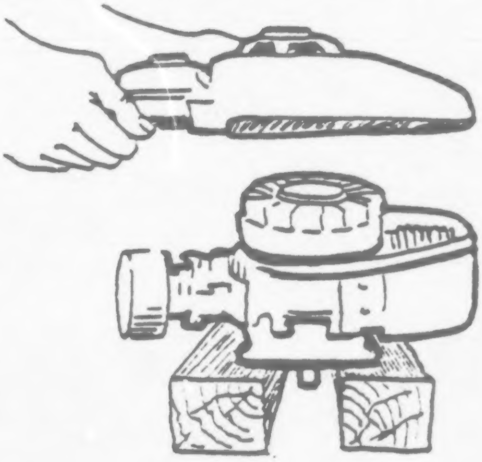


JOB STEPS

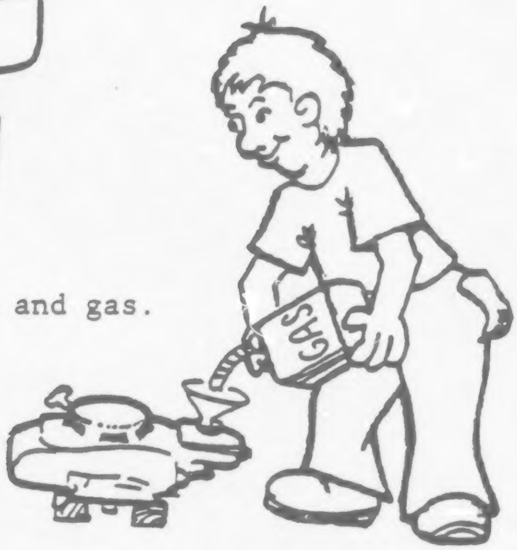
39. Put the head on and torque it down. See Manual for setting.



40. Put the air housing on the engine.

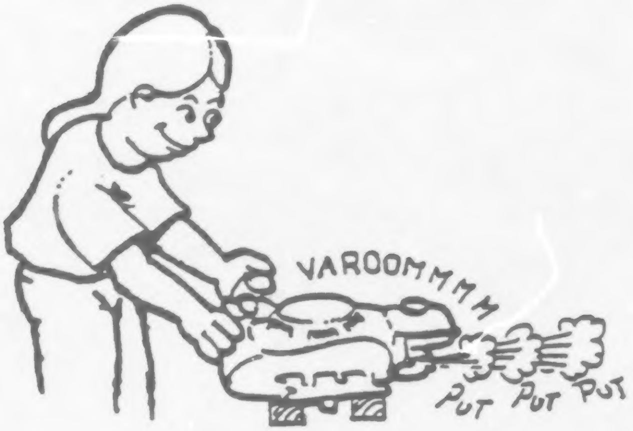


41. Fill the engine with oil and gas.



JOB STEPS

42. Start the engine and adjust it.



43. Check the engine for oil leaks. Then, shut it off.

44. Torque the cylinder head bolts again.

45. Ask your instructor to check your work.

Good job. You have serviced the rings on a small engine.

46. Put away all equipment.

small engine repair

unit: Valves

capital area career center

module: 7501 24 001 **date:** 3/77 **level:** I

skill title: Remove and replace a valve chamber breather or cover.

developed & written by: Don Foster

visuals by: Dave Wehrwein

WORD GUIDE

SPECIFICATIONS - required setting or adjustments. The engine maker usually prints these in a manual or instruction book.

PERFORMANCE OBJECTIVE

You are going to learn:

How to remove and replace the valve chamber breather or cover.

And in order to do this you will need;

a cut-away Briggs and Stratton engine

a torque wrench

a socket set

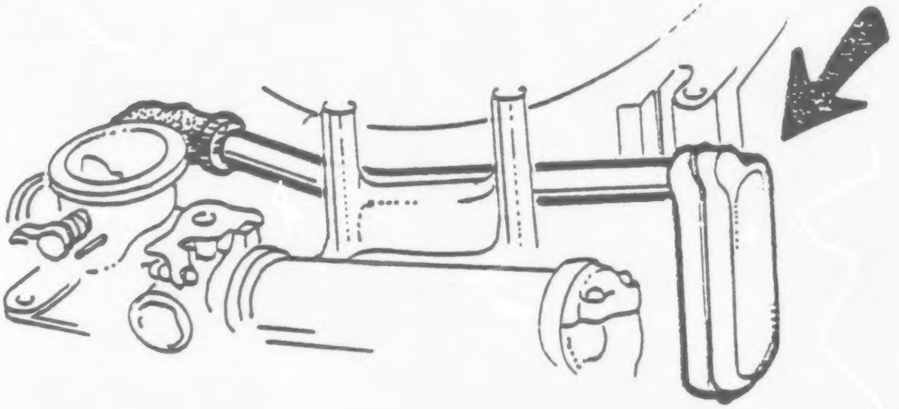
We will know that you can do it when:

You have taken off and put back on a valve chamber or cover with the small holes in the correct position and the bolts are torqued to specifications.

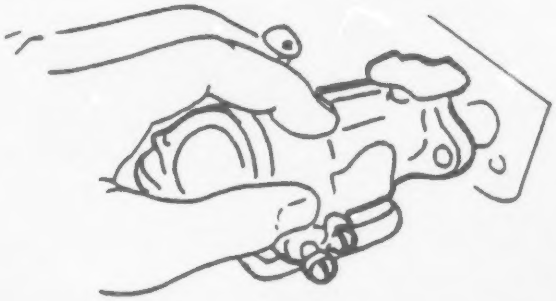
JOB STEPS

1. Find the valve breather on the cut-away engine.

   NOTE: Most breathers are under the carburetor or manifold. In some Briggs and Stratton engines, the breather is on the side opposite the carburetor.

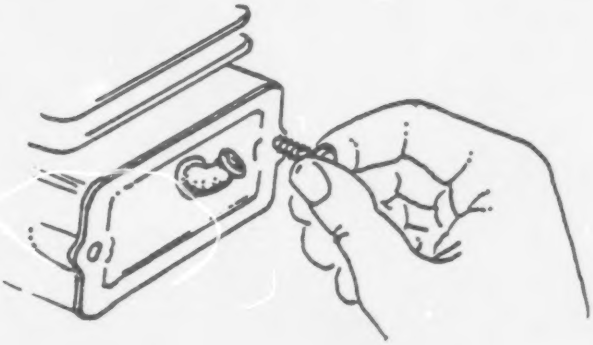


2. If the carburetor is in the way, take it off as you did in Mod 7501 05 005.

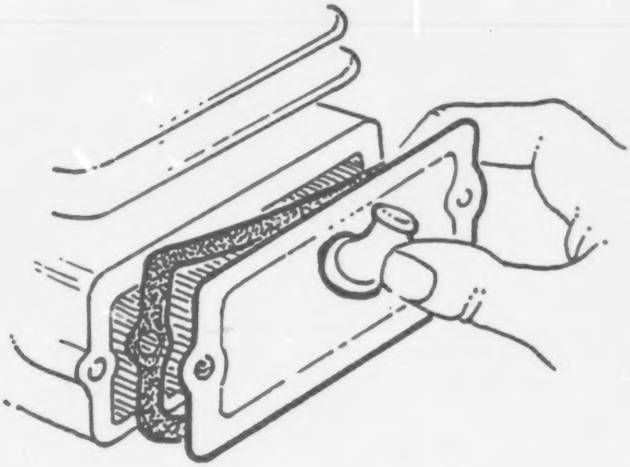


JOB STEPS

3. Take out the bolts or screws which hold the breather.



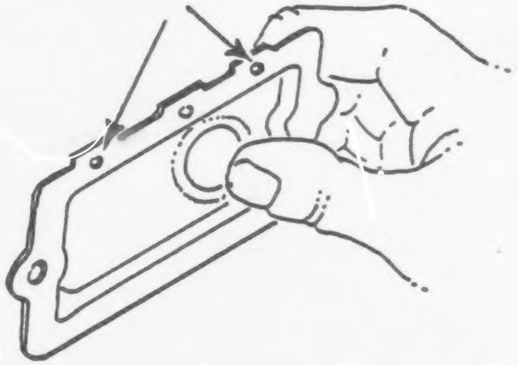
4. Take off the valve breather or cover.



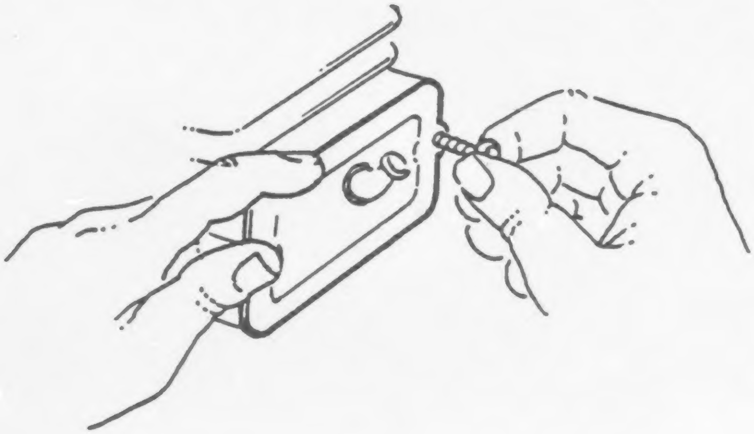
JOB STEPS

5. Look at the valve breather or cover. Note the way it came off. It must be put back the correct way or the engine will burn or leak oil.

6. Check valve breather or cover for the small holes. These holes allow oil to run down into the crankcase. Face the holes down when you put the cover back on.



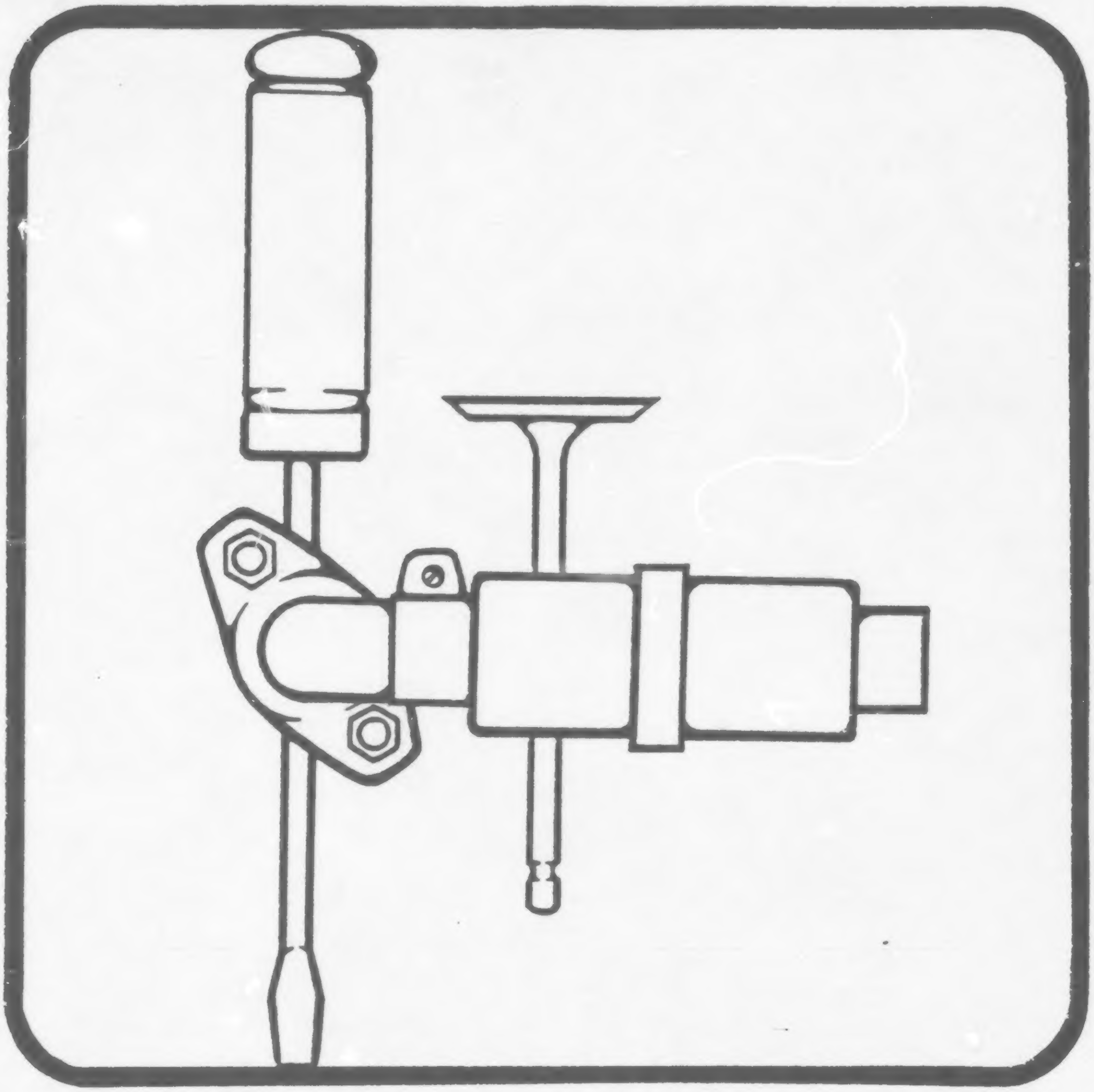
7. Put the breather back on the engine. Be sure to put it on the correct way.



JOB STEPS

8. Torque the bolts to the specifications. Ask your instructor for the torque specifications.

9. Show your instructor that you can remove and replace the valve breather or cover.



small engine repair

unit: VALVES

capital area career center

module: 7501 24 002 date: October 1977 level: I

skill title: Remove and Replace Valve Springs

developed & written by: Don Foster

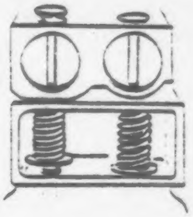
visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

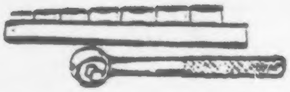
YOU ARE GOING TO LEARN:

How to remove valve springs in a Briggs and Stratton engine.

IN ORDER TO DO THIS YOU WILL NEED:

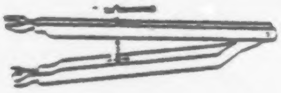


A Display Number II
or an Engine with Valves
in it

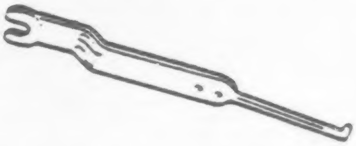


Socket Wrench Set

Safety Glasses



Valve Spring Compressor



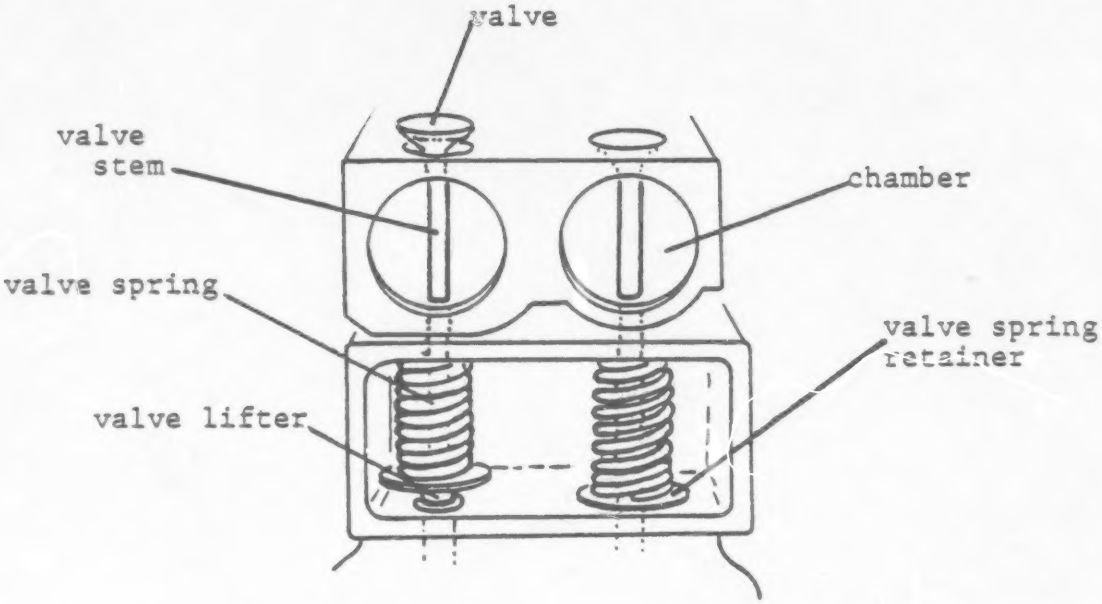
A Valve Tool

WE WILL KNOW YOU CAN DO IT WHEN:

You have removed and replaced the valve springs.

INFORMATION

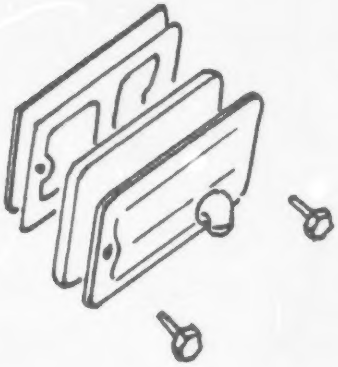
Look at this valve chamber assembly and be sure you know all the parts.

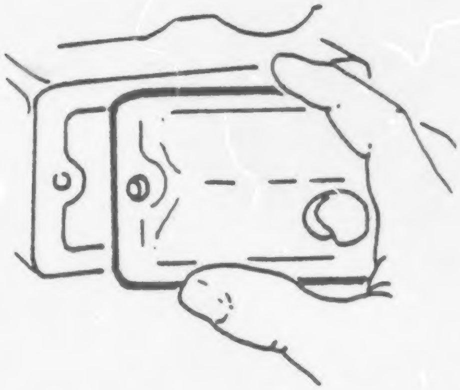

valve
valve stem
chamber
valve spring
valve spring retainer
valve lifter

Then follow the job steps to remove and replace valves.

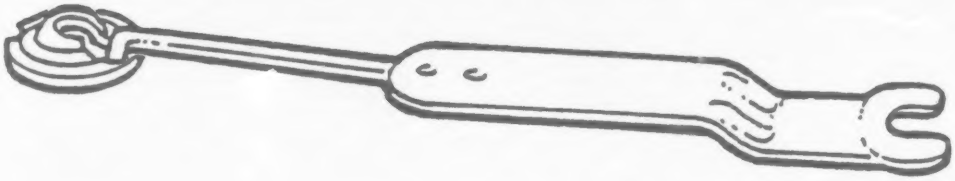
JOB STEPS

1. Remove the valve chamber breather assembly as you learned in module 7501 24 001.



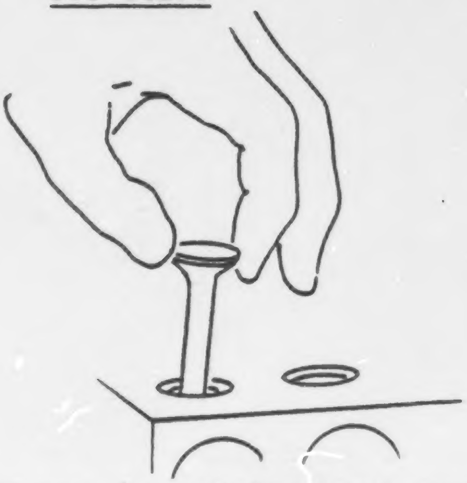


2. Find the groove in the retainer by using the pointed end of the tool. Then find the large hole opposite of the groove.



JOB STEPS

7. Remove the valve:

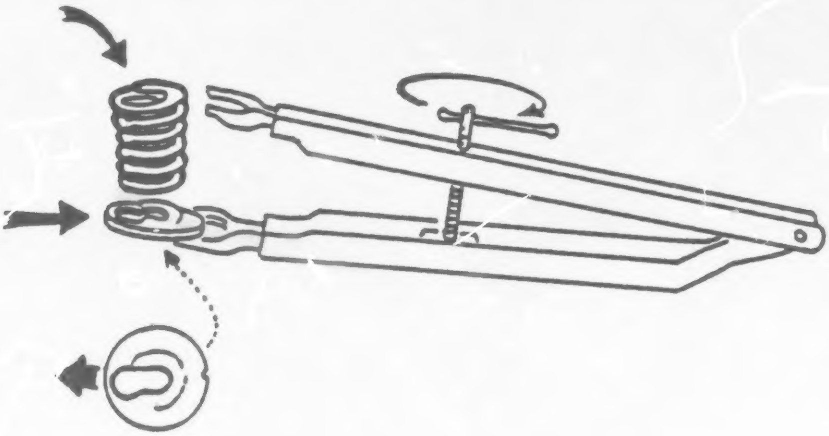


8. Then carefully slide out the retainer and spring.

   NOTE: Be careful to keep track of the spring so you don't mix them up when putting back in.

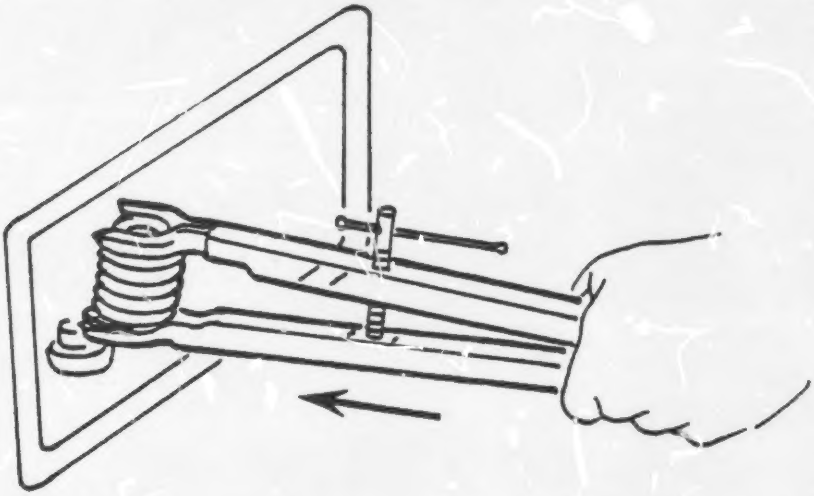
9. When you are ready to return the valve, valve spring, and retainer, put the valve spring and retainer into a valve spring compressor.

   NOTE: The retainer must have its hole toward the inside of the valve chamber, so be sure to put on the compressor in the right way.



JOB STEPS

10. Put the retainer and spring over the lifter and into the chamber. Then release tension on the compressor.



11. Put the valve back in the valve chamber. Push it through the retainer hole.

12. Push down on the compressor, squeezing up the spring and retainer until the valve stem fits into the center of the retainer.

13. Release tension on the compressor and slide it out of the chamber.

14. Check to be sure the valve is back in the center hole of the retainer, and that the valve spring is straight.

15. Have your instructor check your work.

small engine repair

unit: Valves

capital area career center

module: 7501 24 003 date: 7/77 level: I

skill title: Valve Parts Identification and Check Valve Margin

developed & written by: Don Foster

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

You are going to learn:

How to check the parts of a valve.

And in order to do this you will need:

A cut away engine

Several valves

Micrometer

We will know you can do this when:

You can identify the parts of a valve and check the margin with 100% accuracy.

WORD GUIDE

WARP - Bend.

INFORMATION

To do a good valve job, you must know the location and function of the parts of valves. Check the following:

1. Margin of the Valve - The margin must be at least 1/64 of an inch thick. If the margin is too thin, it will burn or warp too easily. Your valve job will not last. If it is not 1/64", throw it away.
2. Face of the Valve - Is it burned or pitted? Or is it grooved from the up-and-down pounding action of the valve? These are common problems.
3. Valve Face Angle - The two most common angles are 45° and 30°; Briggs and Stratton use the 45° on most valves, but some of the later engines use 45° on exhaust and 30° on intake.

An exhaust valve is harder than an intake valve because of the hot exhaust gases going past it. The intake valve runs cooler because every time the intake valve opens, it gets cooled by the fuel mixture coming into the cylinder.

Valves are mostly marked with "X" or "EX" (exhaust valves), "I" or "IN" (intake valves). If valves are not marked, the larger valve will be the intake and the smaller valve will be the exhaust.

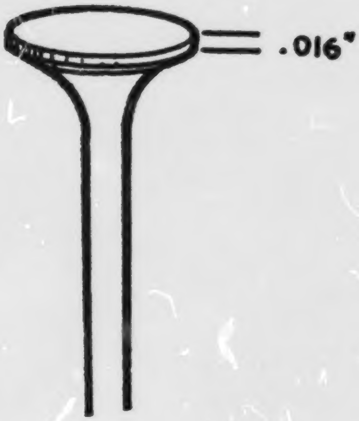
Check to see if the exhaust has "STL" or "ST" on it. This means the valve is a stellite valve. Stellite valves are super-tough valves. Sometimes, standard exhaust valves are used in the intake, while a stellite "EX" valve is used in an engine.

If valves are the same size, you may use an exhaust valve in the intake, but you cannot use an intake valve in the exhaust. Also, sometimes, one of the valve springs is stronger than the other. The stronger spring would be the exhaust spring.

JOB STEPS

1. Get all the equipment and take it to your work area.

2. Locate the margin in this illustration of the valve.

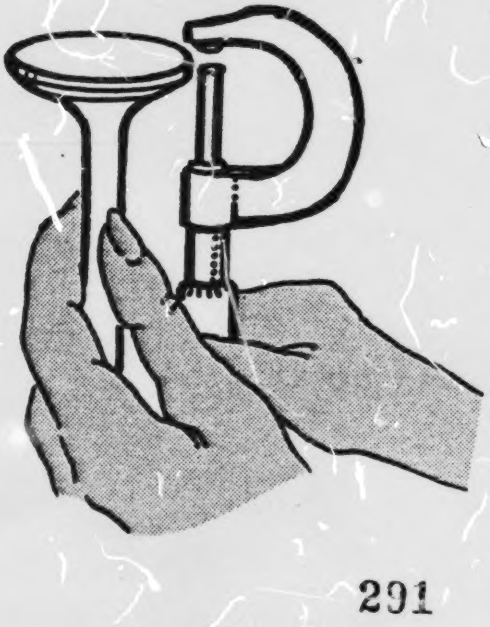


3. An easy way to check valve margins is to:

   A. Set a micrometer at .016 and

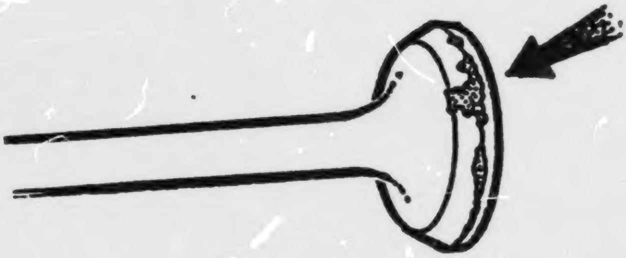
   B. Try to insert the margin into the micrometer.

   If the margin will go in, then the valve is bad and should be replaced. If it won't go in, it can be re-used. Check the valve margins and tell the instructor if the margins are ok.

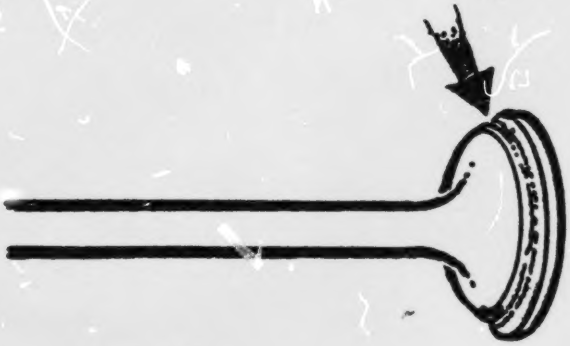


JOB STEPS

4. Look for burned faces on the valve. If the faces are burned, then try to grind the burned spot out on the valve grinder. Stop if the margin gets too small.

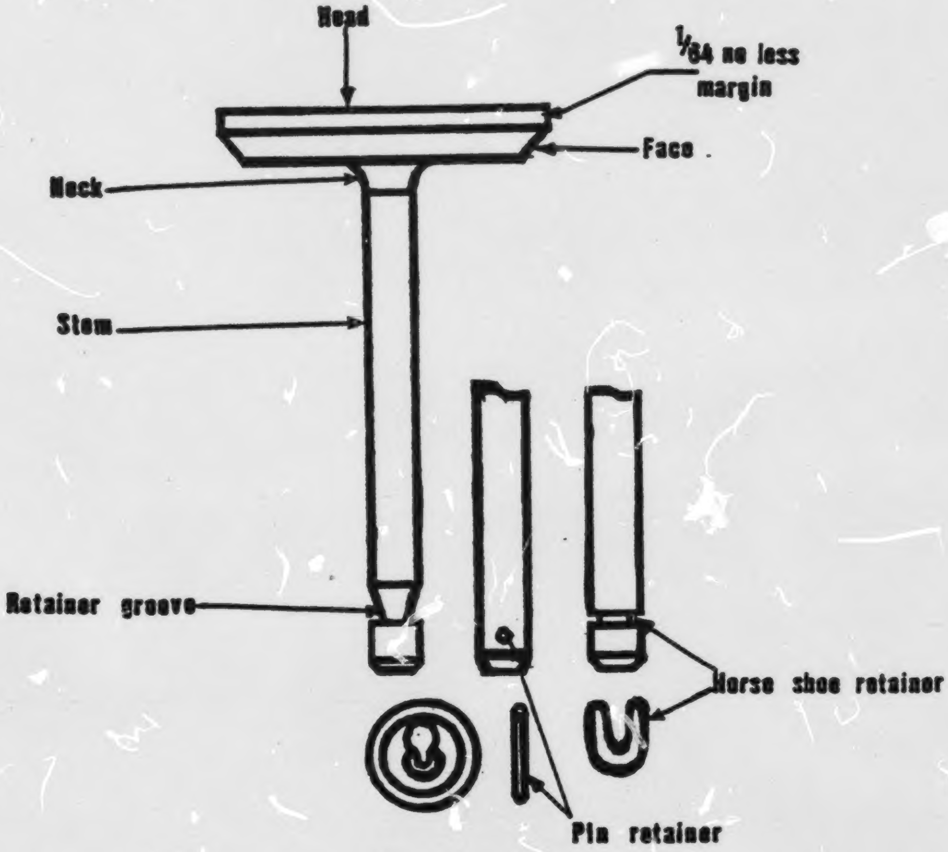


5. Check for pounding wear on the valve. If you find pounding wear, grind the valve on the valve grinder to remove the groove. Watch the valve margin when you grind the valve.



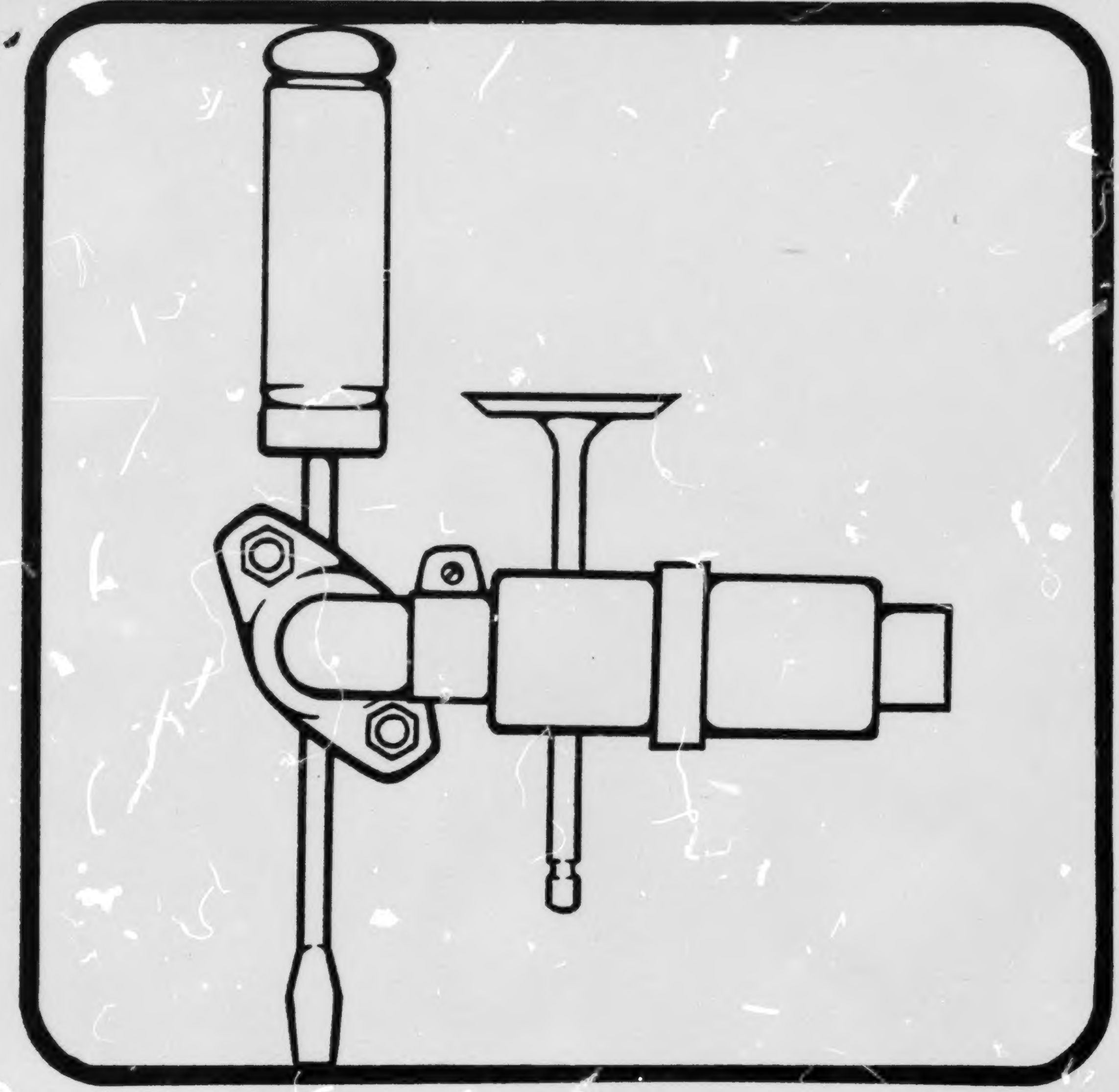
JOB STEPS

6. Study the parts of the valve below.


Head
1/64 no less margin
Face
Neck
Stem
Retainer groove
Horse shoe retainer
Pin retainer

7. Now look at the valve on the next page. Try to name all the parts.

8. Practice until you are sure you can tell your instructor all the parts of a valve.



small engine repair

unit: ____________________

capital area career center

module: 7501 24 004 date: January 1978 level: I

skill title: Identify Parts of Valve Ports

developed & written by: Jim Pitts

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to name the parts of valve ports.

IN ORDER TO DO THIS YOU WILL NEED:

Diagrams

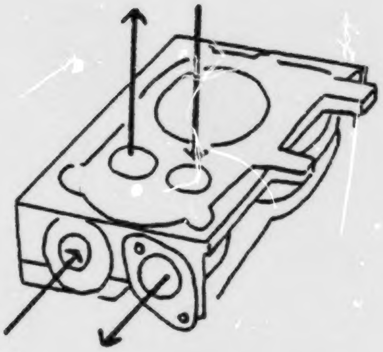
Engine head

WE WILL KNOW YOU CAN DO IT WHEN:

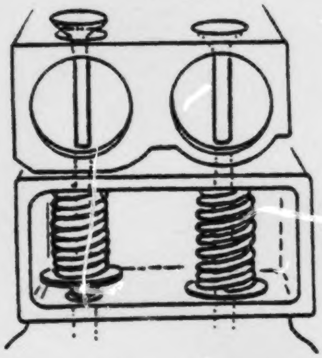
You can name the parts of valve ports.

INFORMATION

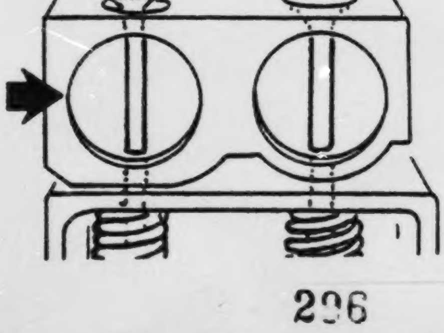
This picture shows the intake and exhaust valves on the side of the piston.



This picture shows the valve in the cylinder block.

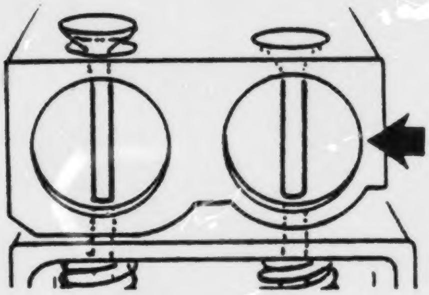


The intake valve port is the hole that the air-fuel mixture goes through to get into the combustion chamber.

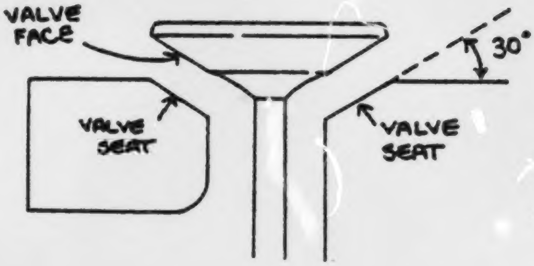


INFORMATION

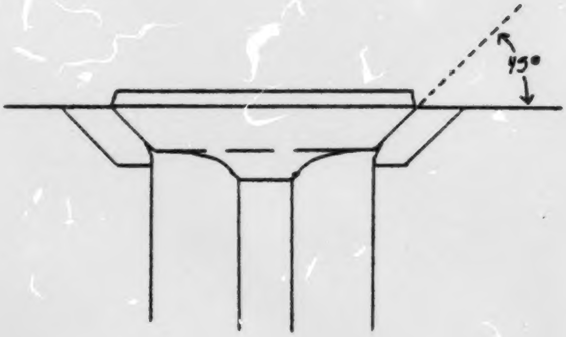
The exhaust valve port is the hole the exhaust goes through from the cylinder to the muffler.



The valve seat is where the face of the valve hits the port to close the valve.

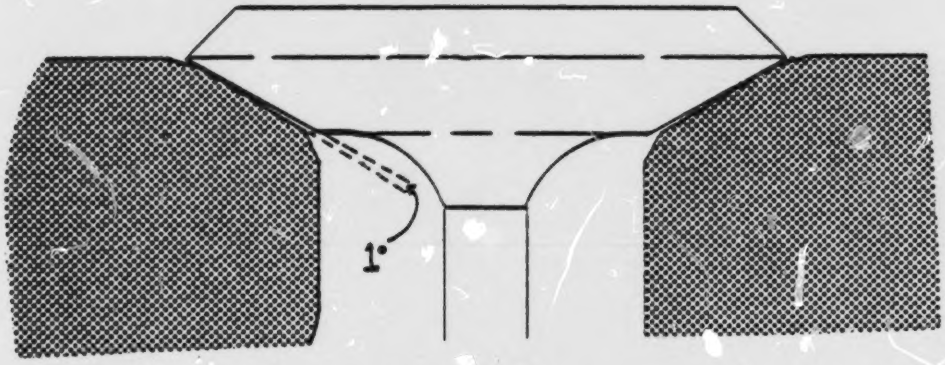

VALVE FACE
VALVE SEAT
VALVE SEAT
30°

The above seat is ground on a 30° angle. Some valve seats are ground on a 45° angle.

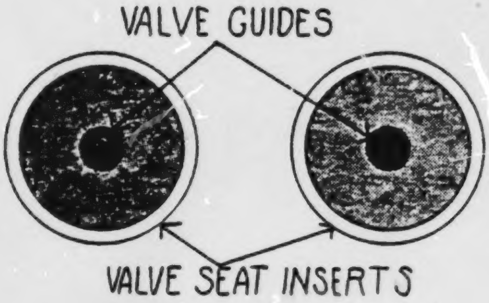


INFORMATION

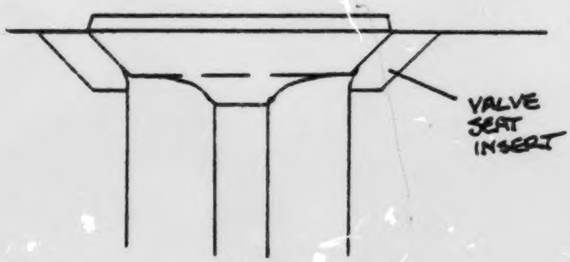
On some valves and ports there is 1° difference between the seat and valve face. This helps the valves to seat faster.



The valve guide is at the center of the valve chamber. The valve guide holds the valve in place.


VALVE GUIDES
VALVE SEAT INSERTS

Some valve seats have inserts. The insert is pressed into the head. It is made of harder metal than the head so the head lasts longer.


VALVE SEAT INSERT

The valve seat is ground on the insert, not the head. The insert can be reground or replaced if damaged.

JOB STEPS

1. Ask the teacher for an engine head.
2. Clean loose dirt and grease off the head. Use cleaning solvent and a brush.
3. Practice finding the parts of valve ports.
4. When you think you know them, show the parts of valve ports to your instructor.

small engine repair

unit: Engine Block

capital area career center

module: 7501 24 005 date: 4/77 level: ______

skill title: Repair Valve Guides on Clinton or Tecumseh Engine

developed & written by: Don Foster

visuals by: Dave Wehrwein

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to ream the valve guide and install the valve on a Clinton or Tecumseh engine.

IN ORDER TO DO THIS YOU WILL NEED:

A bare Clinton or Tecumseh block

Oversize valve

Reamer for the oversize valve

Service manual

WE WILL KNOW YOU CAN DO IT WHEN:

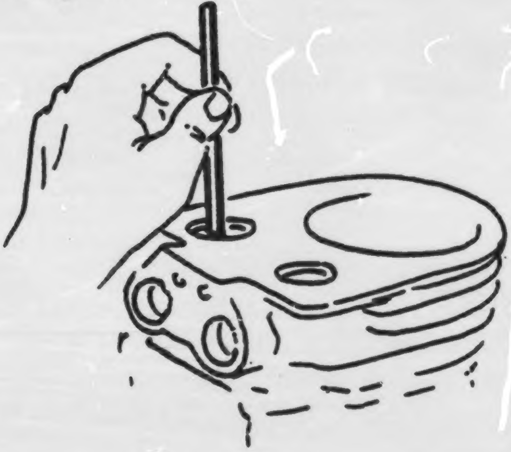
You have worked on the valve guide and valve so that the valve fits with proper clearance.

INFORMATION

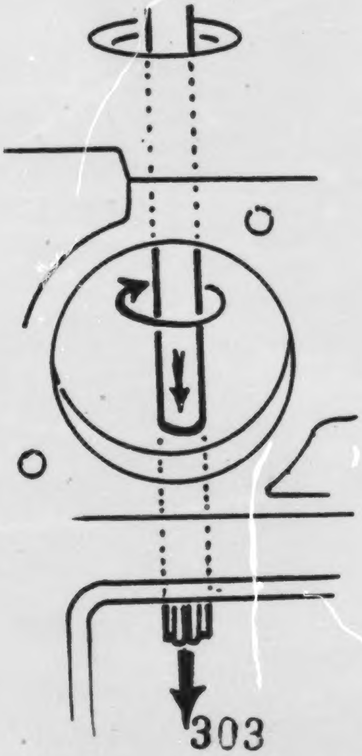
Tecumseh and Clinton engines are different from Briggs and Stratton engines. With Briggs, you ream-out the old valve guide and install a new bronze bushing. With a Tecumseh and Clinton engine, when the valve guides are worn, you ream the old guide 1/32 oversize from standard and then install a valve with an oversize valve stem.

JOB STEPS

1. Take all equipment to your work area.
2. Get proper oversize valve stem reamer. Check manufacturer's manual.
3. Bolt or clamp the block to the bench.
4. Install reamer in worn valve guide so that it is straight. Do not hold at an angle.

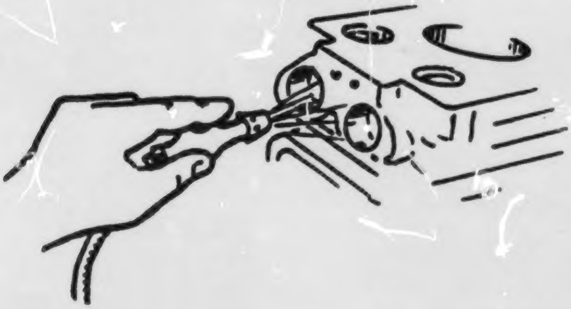


5. Turn reamer to the right and push downward. Then, ream all the way through the guide (Remember: on Briggs blocks you only reamed part way through the guide).

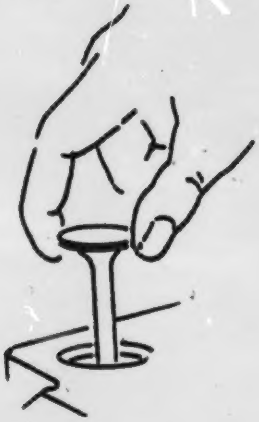


JOB STEPS

6. Use compressed air to blow the metal chips of engine (Be sure you have on your safety glasses).



7. Place the oversize valve in the guide and check that it has free movement up and down.



8. The valve seat may have to be ground if the reamer was off just a little. See the instructor about how to grind the valve seat.

small engine repair

unit: Engine Block

capital area career center

module: 7501 24 006 **date:** 6/77 **level:**

skill title: Install Valve Guides in Aluminum Block Briggs & Stratton

developed & written by: Don Foster

visuals by: Dave Wehrwein

WORD GUIDE

REAM - Open or shape a hole.

INSTALL - Put in.

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

1. How to check a valve guide.
2. Ream-out a worn guide.
3. Install and finish-ream a new guide.

IN ORDER TO DO THIS YOU WILL NEED:

1. A bare Briggs block (no head manifold, breather, etc.)
2. Valve guide reamer
3. Valve guide plug gauge
4. Bushing
5. Valve guide finish-reamer

WE WILL KNOW YOU CAN DO IT WHEN:

The valve stem and guide have the proper clearances according to the manufacturer's specifications.

INFORMATION

READ: "How to Check the Valve Guides", B & S Manual IV, Section 6, Pages 1-4.

As you read the manual, look for the number of the valve guide plug gauge.

Study the drawing of the plug gauge being used, so you will know what to check. Also study diagrams in Figures 9 and 10.

WORD GUIDE

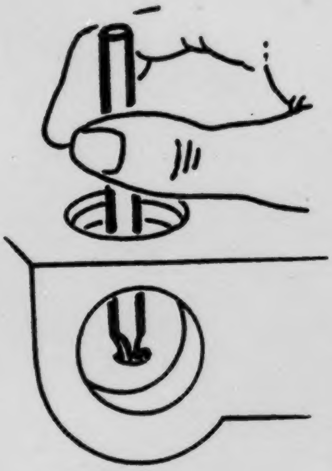
BOTTOMS - Touches the bottom of.

DIAMETER - The length of the straight line passing from one side through the center of an object going to the opposite side.

JOB STEPS

WEAR SAFETY GLASSES!!!

1. Get all equipment and take it to your work area.
2. Try plug gauge in the hole. If it goes in as far or farther than the Manual says, you will have to rebush the guide.



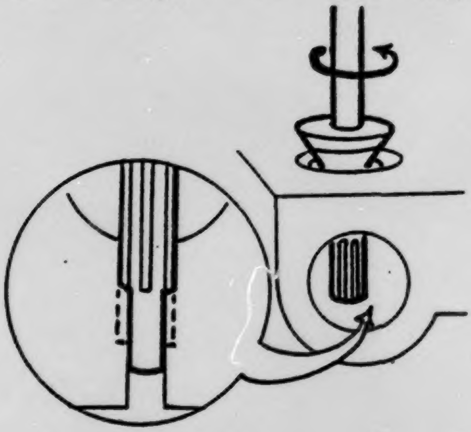
WORD GUIDE

BOTTOMS - Touches the bottom of

DIAMETER - The length of the straight line passing from one side through the center of an object going to the opposite side.

JOB STEPS

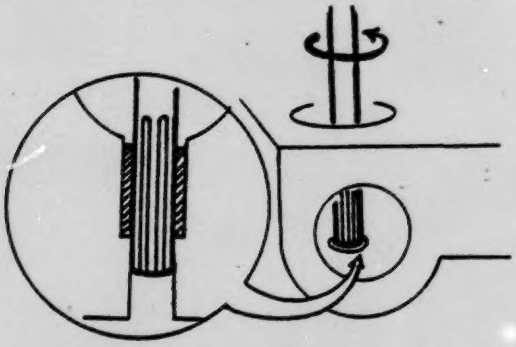
5. If guide needs repair, use the valve guide reamer (same size as outside diameter of bushing) to ream out the guide. Ream it only 1/16" deeper than the length of the bushing.



NOTE: Do not go through bottom of guide.

6. Using valve guide driver, put locktite on outside of bushing. Then, drive in bushing until it bottoms on reamed hole.

7. Using finish reamer, ream-out bushing.



8. Check guide using plug gauge; check guide.

9. After installing the bushing, ground and lap the valve seat.

small engine repair

unit: Engine Block

capital area career center

module: 7501 24 007 **date:** 4/77 **level:**

skill title: Remove and Replace Valve Guides in Cast Iron Briggs and Stratton Engine

developed & written by: Don Foster

visuals by: Dave Wehrwin

310

WORD GUIDE

OPERATE - Run; work

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to remove worn valve guides and replace and ream guides in a cast-iron Briggs & Stratton engine.

IN ORDER TO DO THIS YOU WILL NEED:

A four cycle engine block

Valve guide reamer

Replacement valve guide

Tools (factory special)

Safety glasses

WE WILL KNOW YOU CAN DO IT WHEN:

After you have worked on the valves, your engine operates according to service manual specifications.

WORD GUIDE

NOMENCLATURE - Names (of something)

INFORMATION

Read in B & S Repair Instructions Manual IV, Section 6, Rebuilding valve guides to original diameter, and Valve nomenclature and construction.

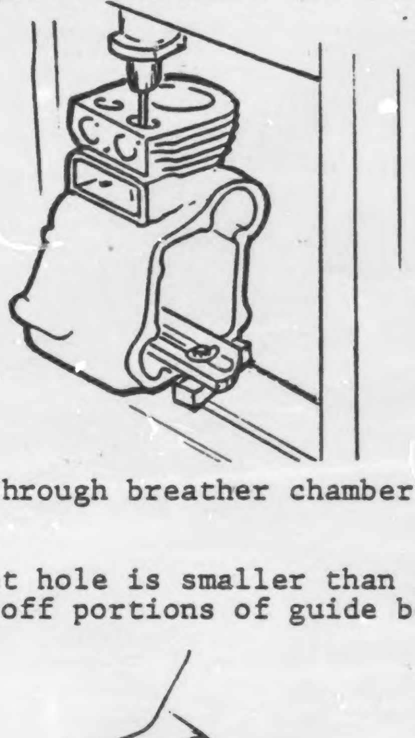
WORD GUIDE

DIAMETER - Distance from, end to end, of a straight line passing through the center of a circle.

JOB STEPS

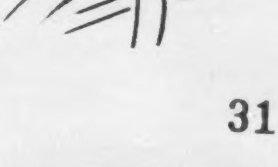
THINK SAFETY - WORK SAFELY!!

1. Take all equipment to your work area. Wear your safety glasses.
2. Check parts manual and service specifications for facts on how to replace valve guides. If you do not have any guides or over-size valves, block must be scraped.
3. Using proper valve guide driver, place block in arbor press and start pressing guide from block (from top to bottom).



NOTE: Watch guide through breather chamber as it is passing downward.

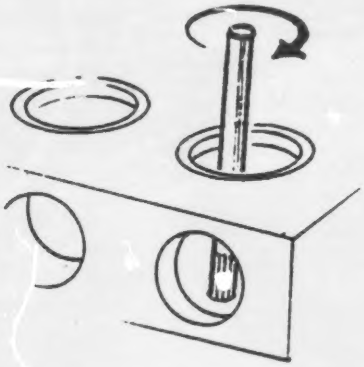
4. If diameter of tappet hole is smaller than length of guide, use pliers to break off portions of guide before bottoming out.



JOB STEPS

5. Place valve guide in block and press into place. (Preheat block to 180° F. and chill valve guide to aid you in doing this job.)

6. Choose proper reamer and ream guide to fit.



small engine repair

unit:

capital area career center

module: 7501 24 010 date: 4/77 level: III

skill title: Service Valves

developed & written by: Don Foster & Dwight Smith

visuals by:

WORD GUIDE

BLOW-BYS - compression (air) blowing by worn rings in an engine or burned valves.

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to remove valves and springs, check valve seats, check valve stems and face for wear and burning, replace valves and set tappet clearances.

AND IN ORDER TO DO THIS YOU WILL NEED:

- four cycle engine
- cycle set
- screwdriver set
- valve spring compressor
- valve seat cutter
- feeler gauge
- micrometer
- lapping compound
- valve lapping compound
- safety glasses

WE WILL KNOW YOU CAN DO THIS WHEN:

You have serviced the valves and have not found any "blow-bys" through the valves.

JOB STEPS

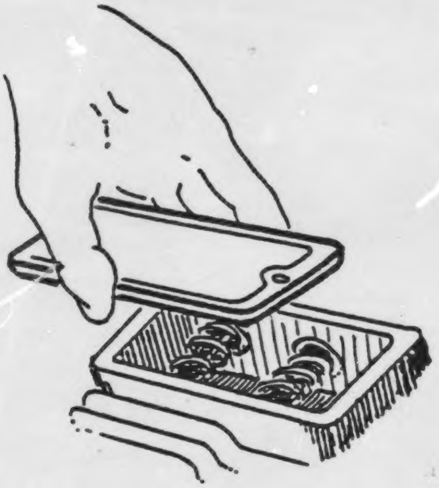
1. Get the tools you need and go to the work area. Ask your instructor which engine you will be working on.

2. Remove the cylinder head.

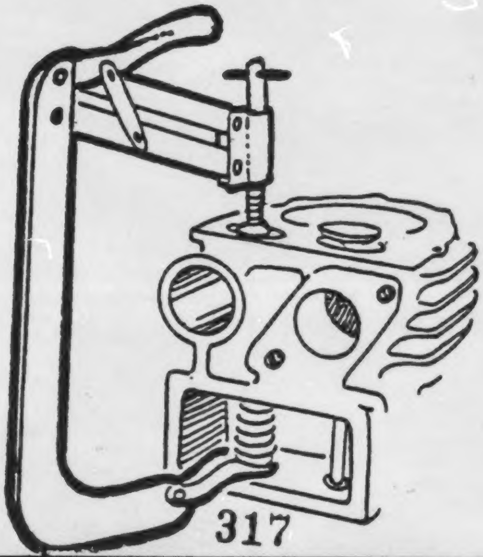
3. For Tecumseh and Clinton engines, remove the carburator and manifold.

   NOTE: For some Briggs engines, the carburator is on the other side and you do not need to remove it.

4. Remove the valve breather assembly.



5. Using the spring compressor, compress the valve spring.

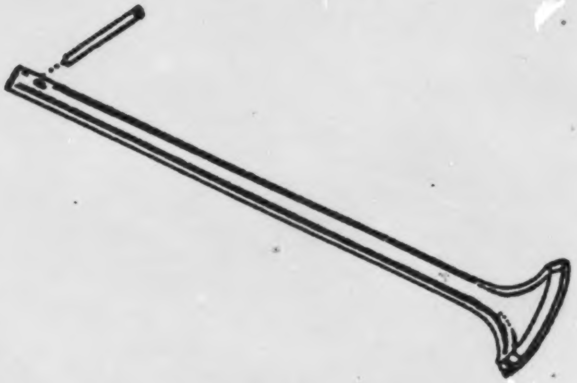


JOB STEPS

6. Remove the valve keeper. It will be a pin, a split-keeper, a horseshoe type valve retainer or regular retainer.

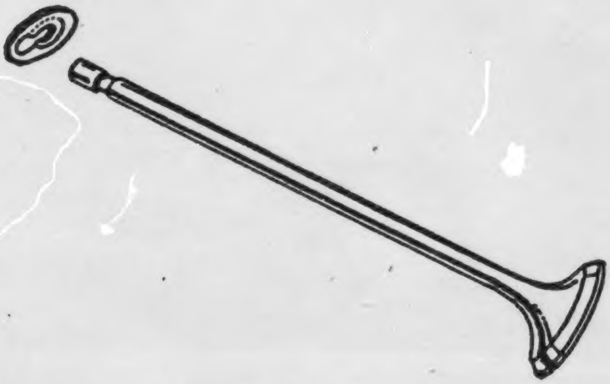
   a. Old type Briggs and Tecumseh:

      Pin type retainer



   b. New type Briggs and Tecumseh:

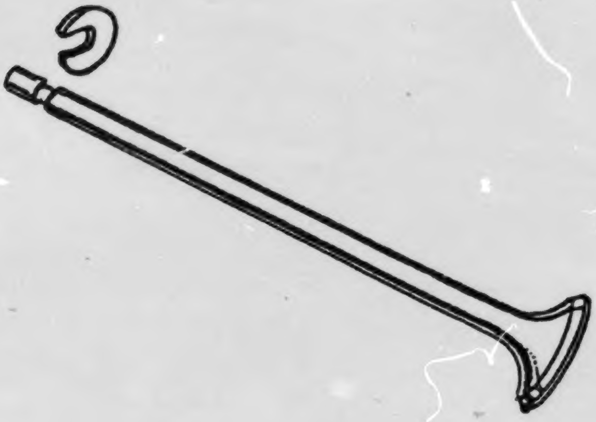
      Retainer only, and a notched valve stem



JOB STEPS

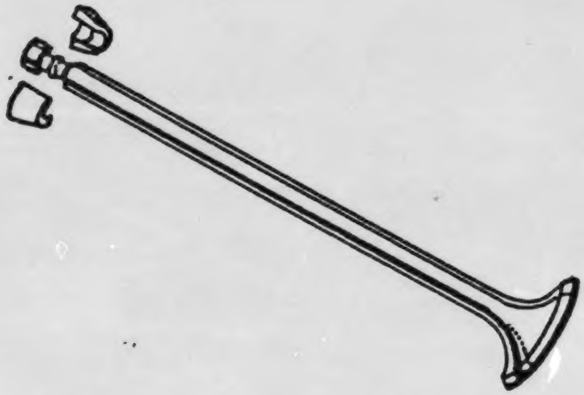
c. Clinton engines:

Horseshoe type



d. Larger horsepower engines (Clinton, Briggs, Tecumseh, Kohler, Wisconsin):

Most have split type retainers



WORD GUIDE

SPECIFICATIONS - exact required settings or adjustments. Using these, the manufacturer explains how their machine must be used.

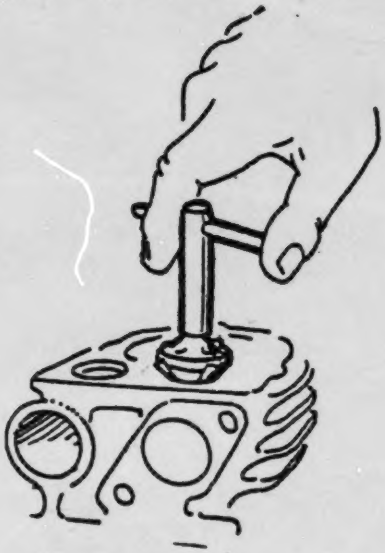
JOB STEPS

7. Remove the other valve as in Job Step 6.

8. Using a wire brush on the grinder, clean the valves. Be sure to get off all carbon. Be careful not to let the brush pull the valve onto the tool-rest.

9. Grind the valves,.your instructor will show you how.

10. Using the Nuway valve-seat cutter re-cut the valve seats to service manual specifications. (30° to 40°).

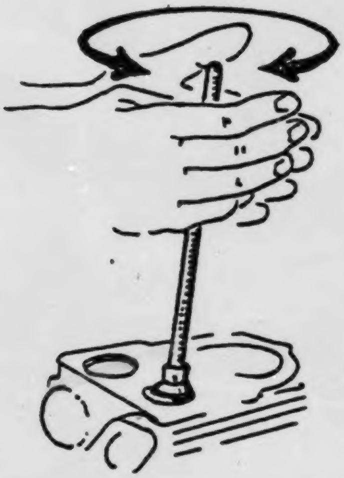


11. Put a small bit of lapping compound on the valve faces. Be sure not to get any on the valve stem. This might wear out the valve quickly when the engine is running.

12. Put the valves back into the correct holes.

JOB STEPS

13. Using the valve-lapping tool, turn the valve back and forth. Do not turn it all the way around. This way, if there is a bad spot on the valve or the seat, it will show up.



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*****************************************
*                                       *
*  CAUTION:  WEAR YOUR SAFETY GLASSES!  *
*                                       *
*****************************************
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14. Take the valves out of the holes. Carefully clean the lapping compound out of the valve seat. Then, clean off the valve.

15. Check your work. Be sure there is a dull, uniform and smooth ring around the valve face.

16. Put the valves back into the engine.

JOB STEPS

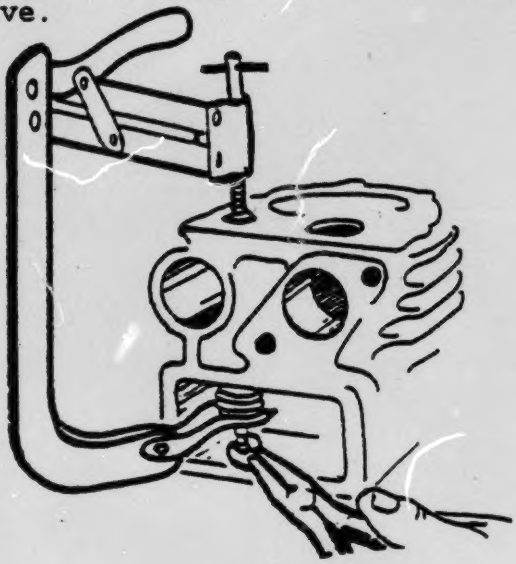
17. Rotate engine to Top Dead Center (TDC) of the compression stroke.

18. Using feeler gauge check the tappet clearances. Be sure to use the right specifications.

19. If the valve tappet clearance is too close, remove the valve. Then, carefully grind the end of the valve stem on the grinder. Take off only a tiny bit at a time (.001 - .0015 in. at a time).

20. When the valve tappet clearances are correct, put the valve springs on the valve.

21. Use the valve spring compressor to compress the valve spring. Put the keepers on the valve.



22. Check to be sure you've correctly put in both valves.

23. Put on the valve chamber breather assembly. Use a new gasket. (Check module 7501 24 001)

JOB STEPS

24. Put a new head gasket on the engine. Check with your instructor to find out if your engine needs one.

    NOTE: Be sure to put it on so that it does not get in the way of the valves.

25. Put the head back on the engine.

26. Using a torque wrench, torque down the head bolts.

27. Put the carburator-manifold on the engine. Also, put on a new gasket.

28. Put on the controls and check them for operation.

29. Check the oil and fuel.

30. Fire-up the engine.

31. Adjust the speed and check for "blow-by." Look for smoke from the valve breather.

Good work. You have finished a valve job on an engine.

small engine repair

unit: Overhaul

capital area career center

module: 7501 25 001 date: 8/77 level: IV

skill title: How to Overhaul an Air-cooled Engine

developed & written by: Jim Pitts

visuals by:

PERFORMANCE OBJECTIVE

YOU ARE GOING TO LEARN:

How to overhaul an air-cooled engine and estimate the cost for a customer.

AND IN ORDER TO DO THIS YOU WILL NEED:

An air-cooled engine and hand tools

Mercotronic tester

Torque wrench

Safety glasses

WE WILL KNOW YOU CAN DO IT WHEN:

The engine starts within 5 pulls, idles at the proper speed, and runs smoothly at full power.

JOB STEPS

1. If the unit is a customer's, be sure you have the work order properly filled out with the right model type and serial number. Be sure the owner has signed the work order.

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capital area career center

SERVICE ORDER FORM

SERVICE ORDER № 243

INVOICE DATE 10-2-75

OWNER NAME John Henery					ENGINE/TRANS. MODEL NO. 16651	NAME OF EQUIPMENT B&S
STREET ADDRESS 111 Elenton St.					TYPE OR SPEC. NO./HOURS 001901	TYPE OF EQUIPMENT Engine Mower
CITY Lansing		STATE Michigan		ZIP CODE 48854		
DATE RECEIVED 9-30-75	DELIVER	PICK UP	CUSTOMER PHONE 676-1000	PROMISED	SERIAL/CODE NO. 111 877	EQUIP. MODEL & SERIAL NO. BS001010

ESTIMATE ONLY ☐	COMPRESSION ☐	ENGINE COOLING ☐	TUNE-UP ☐	CHARGING CIRCUIT ☐	LUBE CHASSIS ☐	REPLACE ENGINE ☐	REPAIR AS NEEDED ☒
CARBURETION ☑	SPEED CONTROL ☐	CHANGE ENG. OIL ☑	MANUAL STARTER ☐	SAFETY INTERLOCK ☐	OVERHAUL ☒	PREPARE FOR STORAGE ☐	☐
IGNITION ☑	AIR CLEANER ☐	SHARPEN ☐	ELECTRIC STARTER ☐	BELTS ☐	SHORT BLOCK ☐	WARRANTY ☐	☐

QTY	PART NO AND DESCRIPTION	AMOUNT	DESCRIPTION OF WORK	AMOUNT
1	Cleaner element		Overhaul engine	
			engine maintend	
			GALS. OF GAS @	TOTAL LABOR
			QTS. OF OIL @	TOTAL PARTS
			LBS. OF GREASE @	ACCESSORIES
				GAS, OIL AND GREASE
			I hereby authorize the above repair work to be done along with the necessary materials. You and your employees may operate above vehicle for purposes of testing, inspection, or delivery at my risk. An express mechanics lien is acknowledged on above vehicle to secure the amount of repairs thereto. It is also understood that you will not be held responsible for loss or damage to cars or articles left in cars in case of fire, theft or any other cause beyond your control.	OUTSIDE REPAIRS
				TAX
	TOTAL		SIGNATURE John Henery	TOTAL

T&1-02

Thank You

JOB STEPS

2. After you have made sure that the order is properly filled out, remove the third sheet, or the hard copy (cardboard type paper).

3. Then, take the two top sheets of the work order to the Parts Department.

   NOTE: You will work off of the hard copy. List many parts you need, in the "material used" area of the work order.

4. If the engine is mounted, be sure to make a note on the hard copy so that when the order is figured, the customer will be charged for that extra time.

WEAR SAFETY GLASSES!

5. If the engine is mounted, remove it from its mount as you learned in Unit 15.

6. If the engine is very dirty, power wash or steam clean it. This will keep the internal engine parts clean.

7. Remove air filter (Check the air filter oil bath. Does it have enough oil? Is it clean? If it is full of dirt, the engine may be damaged). Checking the filter can tell you about the condition of the engine.

8. Put a new air filter element on the list, if needed.

   NOTE: If the air filter is oily, the rings and valves are not sealing properly (use module 7501 02 002).

9. Remove the carburetor and make a note of how the governor is hooked-up (use mod from Unit 5 as a guide).

WORD GUIDE

DISASSEMBLE - Take apart.

FRAYED - Ripped, torn.

JOB STEPS

10. Check the governor linkage for wear (enlarged holes in the carb throttle plate). Look at the bends. If the link is worn, list the part you need on the hard copy.

11. Check the holes in throttle plate where the governor link goes.

12. Check the throttle shaft for looseness. Disassemble the carburetor (remove any rubber or neoprene parts). If you want to install a carburetor rebuild kit, put in on the list now (use a mod from Unit 5 as a guide).

13. Remove the air-housing, if this engine uses a rewind starter in the housing.
    A. Pull the rope all the way out.
    B. Check to see if the rope is frayed. Does the rope go all the way back in? Follow the steps in module 7501 03 004.

14. If the starter needs parts, put that on the list also (use a mod from Unit 3).

15. Now, remove the flywheel nut or starter clutch assembly.

16. Remove the flywheel. If you don't remember how to do it, read mod 7501 08 001 over.

17. Use mercotronic tester to check coil, condenser and points. Use mods 7501 13 001, 7501 13 002, and 7501 13 003. Write down the list of parts you will probably need.

WORD GUIDE

EXCESSIVELY - More than usual.

JOB STEPS

18. Now you can remove the head. Ask these questions:

    A. Is the head gasket blown?

    B. How much carbon is there in the head and on the piston?

    C. Is the carbon hard or oily?

    NOTE: If there is a lot of oil in the carbon, that could mean that the rings are very bad or possibly that the cylinder will need to be rebored. If the carbon is hard, then the rings may need replacing, but the cylinder may not need reboring (see mod 7501 01 003).

19. Drain the oil.

20. After the oil is drained, hold the crankshaft and try to wiggle it. If it moves excessively, replace the sump or install new main bearings (see mod 7501 01 001).

21. Remove the sump or the side cover. (If this engine is a vertical shaft with a power take-off out the side, be sure to review mod 7501 01 002 because there is a hidden bolt).

    NOTE: Add oil seals to your list. Also, since you have already removed a few gaskets, add a new gasket set to your list. Never use an old gasket because it can't be compressed properly and may leak.

22. Notice the way that the rod is installed on the crankshaft. Is there an oil dripper on the rod? How is it installed? Make a note on the hard copy so you don't forget (see mod 7501 01 009).

JOB STEPS

23. Before you loosen the rod bolts or nuts, you should rotate the crankshaft until the piston is in the middle of the stroke (that would put the piston about one inch or so from the top of the cylinder).

24. Twist the crankshaft back and forth a litte and notice if there is any play between the rod and the crankshaft. If there is, you will have to mike the crankshaft and will need a new rod. Add a new rod to the list (use mod 7501 01 009).

25. Loosen the rod bolts and remove the rod cap and dipper (if there is one).

26. Very carefully, push the rod and piston to the top of the cylinder. Very carefully, push the piston and rod out of the cylinder. Be ready to catch the piston as it comes out.

27. Now, using the manual, remove the rings from the piston and check the piston skirt clearance. Remember to check it opposite the wrist pin bosses. If the clearance is all right, go to step 28. If not, it will have to be rebored. If it has to be rebored use mod 7501 16 004.

28. Check piston ring land clearance, if you are going to use the old piston. If it fails this test, put a new piston on the list of parts you will need. Follow mods in unit 23.

29. Remove the camshaft and tappets. Check for cracks and/or broken teeth. Mike the lobes on the camshaft. Check the manual to see if there is a spec on it. Follow mods in Unit 24.

30. Remove and mike the crankshaft. Check the chart for reject sizes. See mod 7501 01 021 for information on how to properly mike a crankshaft.

JOB STEPS

31. Remove the valve chamber breather assembly or cover (use 7501 24 001).

32. Remove the valve springs and retainers (use 7501 24 002).

33. Remove the valves and clean them on the wire brush.

34. Grind the valves and seats at the proper angle. If the seat is too wide or too high on the valve face, be sure to relieve the seat (use mod 7501 24 010).

35. If the valves need replacing, put them on the parts list.

36. Now check the valve guides. If they need replacing, add them to your list (use mod 7501 24 006 or mod 7501 24 007).

WEAR YOUR SAFETY GLASSES!

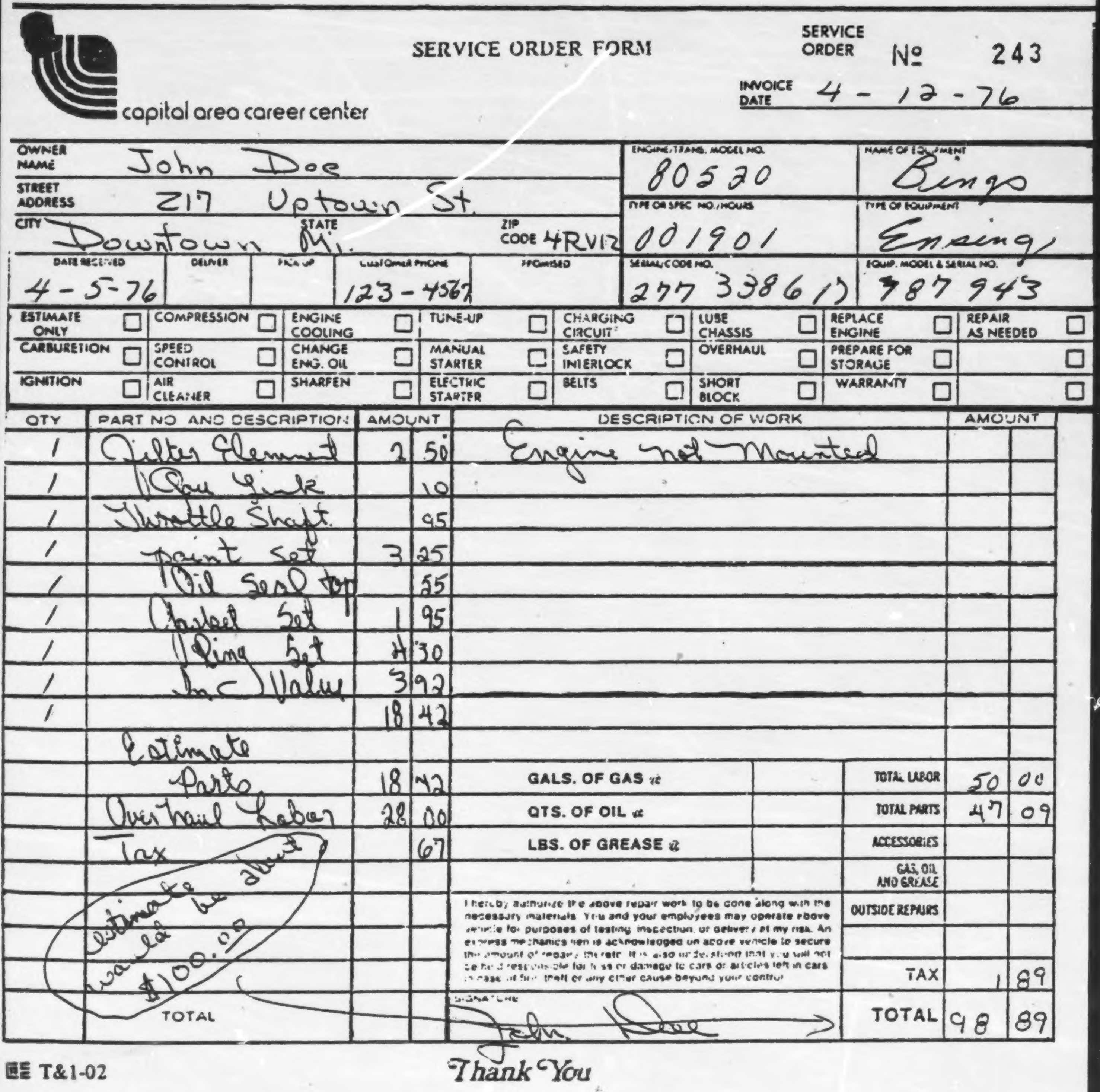
37. Before doing anything else, be sure you have all parts you will need. Go back over the list and check. Also, is the muffler all right? Is the wristpin in good condition? If not, use mod 7501 01 009.

38. If you are satisfied that you have all the parts listed, take the list to the Parts Department and have them look up the price of the parts so you can call the customer with an estimate. See example on next page.

39. When you get back the list of parts and prices, total them and add the tax.

40. Then, estimate and total the labor using a flat rate chart or manual.

JOB STEPS



capital area career center

SERVICE ORDER FORM

SERVICE ORDER № 243

INVOICE DATE 4 - 12 - 76

OWNER NAME John Doe		ENGINE/TRANS. MODEL NO. 80520	NAME OF EQUIPMENT Briggs
STREET ADDRESS 217 Uptown St.		TYPE OR SPEC NO./HOURS 001901	TYPE OF EQUIPMENT Engine
CITY Downtown	STATE Mi.	ZIP CODE 4RV12	

DATE RECEIVED	DELIVER	PICK UP	CUSTOMER PHONE	PROMISED	SERIAL/CODE NO.	EQUIP. MODEL & SERIAL NO.
4-5-76			123-4567		277 338617	787 943

ESTIMATE ONLY ☐	COMPRESSION ☐	ENGINE COOLING ☐	TUNE-UP ☐	CHARGING CIRCUIT ☐	LUBE CHASSIS ☐	REPLACE ENGINE ☐	REPAIR AS NEEDED ☐
CARBURETION ☐	SPEED CONTROL ☐	CHANGE ENG. OIL ☐	MANUAL STARTER ☐	SAFETY INTERLOCK ☐	OVERHAUL ☐	PREPARE FOR STORAGE ☐	☐
IGNITION ☐	AIR CLEANER ☐	SHARPEN ☐	ELECTRIC STARTER ☐	BELTS ☐	SHORT BLOCK ☐	WARRANTY ☐	☐

QTY	PART NO AND DESCRIPTION	AMOUNT	
1	Filter Element	2	50
1	Gov Link		10
1	Throttle Shaft.		95
1	point set	3	25
1	Oil Seal top		55
1	Gasket Set	1	95
1	Ring Set	4	30
1	In Valve	3	92
1		18	42
	Estimate		
	Parts	18	42
	Overhaul Labor	28	00
	Tax		67
	TOTAL		

estimate would be about $100.00

DESCRIPTION OF WORK	AMOUNT	
Engine not Mounted		

GALS. OF GAS @		TOTAL LABOR	50	00
QTS. OF OIL @		TOTAL PARTS	47	09
LBS. OF GREASE @		ACCESSORIES		
		GAS, OIL AND GREASE		
		OUTSIDE REPAIRS		
		TAX	1	89
		TOTAL	98	89

I hereby authorize the above repair work to be done along with the necessary materials. You and your employees may operate above vehicle for purposes of testing, inspection, or delivery at my risk. An express mechanics lien is acknowledged on above vehicle to secure the amount of repairs thereto. It is also understood that you will not be held responsible for loss or damage to cars or articles left in cars in case of fire, theft or any other cause beyond your control.

SIGNATURE John Doe

T&1-02

Thank You

41. Then, add the total parts, total labor and tax.

WORD GUIDE

ALIGN - Put in position.

JOB STEPS

47. Correctly install the new rings on the piston and have the Instructor check the rings before you install the rod and piston in the cylinder (use mod 7501 23 001).

48. Install the piston ring compressor and be sure to coat the rings and piston with oil (use mod 7501 23 002).

49. Very carefully install the piston and rod assembly in the cylinder. Be sure that the rod is going back in the proper position (use mod 7501 01 009).

50. Be sure to lubricate the rod or crank pin of the crankshaft.

51. Install the rod cap, and torque to proper specification (use mod 7501 01 009).

52. Bend the rod locks, if used. Have the Instructor check the rod locks.

53. If the engine is a vertical shaft, install the oil slinger, if used (use mod 7501 01 025).

54. Install the tappets and camshaft (be sure to lubricate the camshaft bearings) and be sure to align the timing marks. Now, have the Instructor give a final inspection (use mod 7501 01 004).

55. Install the new gasket on the block (if the gasket is shrivelled, you will have to soak it in water).

JOB STEPS

42. When you have the total, round it off to the next highest dollar. Then add ten dollars to the total, call the customer and give him/her the estimate price.

    NOTE: Adding ten dollars because:

    1. You are protecting yourself, in case you missed something.
    2. When the customer comes to pick up the machine and the bill is lower than the highest price quoted, then the customer is happy. But if the bill is over the estimate quoted, he will not be happy. So always, estimate a little high.

43. When you get permission to repair the engine, write down on the order:

    1. To whom you talked.
    2. The time.
    3. The date.

    Give the order to the Parts Department and have them pull the new parts for you.

44. Clean all of the parts before you reassemble the engine. Clean, dry and lay them out in order so you don't forget to install a part.

    REMEMBER: Clean carb parts in cleaner after you have received permission.

    WEAR SAFETY GLASSES!

45. Rebore or deglaze the cylinder (use mod 7501 23 003).

46. Install the rings in the cylinder and check the end gap of the rings. Be sure the wrist pin locks are in and tight (use mod 7501 23 003).

WORD GUIDE

MESHED - In line with, linked to; attached.

JOB STEPS

56. Now you should be sure to lubricate the other main bearing and install the sump (use mod 7501 01 001).

57. If you have a mechanical governor gear on your sump, and (as you push it down the shaft) if the sump doesn't go all the way down to the block, don't force the sump because the plastic governor gear may not be meshed with the cam gear). With one hand, gently push the sump toward the block and, with the other hand, rotate the crankshaft until the gear aligns with the other gear, and the sump slides all the way to the block.

58. Now install two bolts and tighten them (or torque, if there is a spec given in the repair manual).

59. Check the end play in the crankshaft and adjust, if needed. Have the Instructor check it. If it is all right, install both oil seals (use mod 7501 01 017).

60. You are now ready to install the valves. First, you must check the valve clearance. Be sure to check the chart.

61. Grind the proper clearance on the valve stem. Have the Instructor check your work up to this point (use mod 7501 24 010).

62. Now, hook up the valve springs and retainers (use mod 7501 24 002).

63. Install the valve breather assembly and be sure that the drain hole for the oil is pointed down.

64. Resurface the head. If you don't remember how, then get mod 7501 01 003.

JOB STEPS

65. Install the head and torque it to the proper specs. Also, be sure to install any shrouding or shut-offs that go under the head bolts. On Tecumseh, do this step after timing the mag (use mod 7501 01 003).

66. Start working on the magneto. Install the point plunger and install the points, coil, and condenser (use a mod from unit 8).

67. Set the points according to manufacturer's specifications (usually .020).

68. Wipe a clean piece of lintless paper through the points to clean them and install the flywheel.

69. Key loosely and spin the flywheel to check for spark.

70. If you had spark, then install the cover on the points and recheck for spark.

71. Then, install the flywheel nut or clutch (if clutch is used to hold the flywheel on, be sure to oil or grease the shaft). Use mod 7501 08 001.

72. Adjust the armature or coil clearance to the flywheel. You will find this information on the chart (usually .010).

73. Remove the carburetor from the carb cleaner and blow it out with the air hose. Open up the carb repair kit and check to be sure all of the part are there. If there are instructions in the carb kit, read them before trying to put it back together (use a mod from unit 5).

74. Reassemble the carb (check float level, needle adjustment, etc).

JOB STEPS

75. Install the carb back onto the manifold or block.

76. Hook-up the governor link to the proper hole in the throttle plate of the carb.

77. Install the carb on the engine. Be sure to adjust the governor linkage and that all of the linkage is free of binding.

78. Install the air housing or starter assembly (use mod 7501 05 006).

79. Be sure the air filter has been cleaned properly. Also, if needed, re-oil the filter (use mod 7501 02 001).

80. Now mount the engine and fill with oil to the proper oil level (use a mod from unit 15).

81. Start, adjust and check for oil leaks (use mod 7501 05 007).

82. If the engine is used on a rotary mower, be sure to use the tachometer to check top speed warning. DO NOT EXCEED THE BLADE TIP SPEED LAW.

83. Have the instructor check your work.